4(d) Rule Limit 6
Proposed Evaluation and Pending Determination

Title of RMP: Lake Ozette Sockeye Salmon Resource Management Plan - Hatchery and Genetic Management Plan Component

RMP Provided by: The Makah Tribe (for the Bureau of Indian Affairs) and the Washington Department of Fish and Wildlife (WDFW)

ESU: Ozette Lake Sockeye Salmon Evolutionarily Significant Unit

4(d) Rule Limit: ESA 4(d) Rule Limit 6

NMFS Tracking Number: NWR/4d/06/2001/003

BACKGROUND

The National Marine Fisheries Service (NMFS) issued a final Endangered Species Act (ESA) 4(d) Rule adopting regulations necessary and advisable to conserve Ozette Lake sockeye salmon (50 CFR 223.203(b); 65 FR 42422, July 10, 2000). Under Limit 6 of the Rule, ESA section 9 take prohibitions do not apply to hatchery activities that are undertaken in compliance with a resource management plan (RMP) developed jointly by the Tribes and the State of Washington that is consistent with the 4(d) Rule criteria. The Makah Tribe and, as co-managers of the fisheries resource with the tribe under *United States* v. *Washington* (1974), WDFW (hereafter referred to as "the co-managers"), have provided NMFS a RMP for hatchery and associated research and monitoring and evaluation actions that will affect listed Ozette Lake sockeye salmon. The proposed RMP provides the framework through which the tribal and the state jurisdiction can jointly manage the sockeye salmon hatchery, research, and monitoring and evaluation activities while meeting requirements specified under the ESA. The co-managers have provided the RMP for review and determination by NMFS that it addresses the criteria of Limit 6 of the 4(d) Rule, and that limits on application of ESA section 9 take prohibitions will therefore apply for hatchery and associated research and monitoring and evaluation actions operating consistent with the RMP. These resource management actions are described by the co-managers for NMFS' consideration in the form of a Hatcheries and Genetic Management Plan (HGMP). For the purposes of this document, the co-manager's RMP will therefore also be referred to as an HGMP.

EVALUATION

The final 4(d) Rule for the Ozette Lake Sockeye Salmon Evolutionary Significant Unit (ESU) states that the prohibitions of paragraph (a) of the rule (50 CFR 223.203(a)) do not apply to actions taken in compliance with an RMP jointly developed by the States of Washington, Oregon and/or Idaho and the Tribes, provided that elements of the rule are met, including the following:

> (1) The Secretary of Commerce (Secretary) has determined pursuant to 50 CFR 223.209 [the Tribal 4(d) Rule] and the government-to-government processes therein that implementing and enforcing the joint tribal/state plan will not appreciably reduce the likelihood of survival and recovery of affected threatened ESUs.
>
> (2) In making that determination for a joint plan, the Secretary has taken comment on how any hatchery and genetic management plan addresses the criteria in §223.203(b)(5).

As per the Tribal 4(d) Rule, NMFS consulted regularly with the Makah Tribe during the development of the RMP through government-to-government and technical work group meetings. These occasions presented the opportunity to provide technical assistance, to exchange information and discuss what would be needed to conserve the listed species, and to be consistent with legally enforceable tribal rights and with the Secretary's trust responsibilities to the tribes.

The following is an evaluation of whether the RMP meets the criteria specified in §223.203(b)(5)(i), as referenced under Limit 6 of the final 4(d) Rule for Ozette Lake sockeye salmon (65 FR 42422, July 10, 2000).

Limit to Take Prohibitions Criteria and RMP Evaluation

(5)(i) A state or Federal Hatchery and Genetics Management Plan (HGMP) has been approved by NMFS.

The HGMP submitted by the co-managers for NMFS approval describes proposed Ozette Lake sockeye salmon artificial propagation, research, and monitoring and evaluation actions affecting listed Ozette Lake sockeye salmon within the waters of the State of Washington.

The HGMP guides co-manager activities proposed to increase the number of naturally spawning sockeye salmon in Ozette Lake tributaries, and to collect scientific information regarding factors limiting the productivity of listed Ozette Lake sockeye salmon, including the potential effects of hatchery sockeye salmon production. Proposed actions described in the HGMP are the collection and spawning of 200 sockeye salmon adults from Umbrella Creek, an Ozette Lake tributary. Adult fish used as broodstock originate from juvenile hatchery fish releases of indigenous Ozette Lake sockeye salmon stock. Progeny of these tributary-origin fish will be artificially propagated for several months and released into Umbrella Creek and Big River (an adjacent tributary) to establish and enhance adult returns to the tributaries in subsequent years. Approximately 216,000 unlisted

juvenile sockeye salmon will be released at the "fry" life stage (35 to 55 cm in fork length) into the natural environment each year. HGMP research programs include collection of 10 adult sockeye salmon from Ozette Lake spawning beaches each year for spawning. Eggs spawned from these fish will be used for egg survival studies on Ozette Lake spawning beaches to determine the extent to which beach conditions limit productivity. Fish counting weirs will be operated in the upper Ozette River and in Umbrella Creek to accurately enumerate total annual sockeye salmon adult returns to the lake, and hatchery and natural-origin returns to the tributary. Further life history and limiting factors research includes capture, handling, radio/sonic tagging and release of 200 sockeye salmon adults from the run at large in the Ozette River for lake migration, spawning behavior, and pre-spawning survival surveys in Ozette Lake in 2001 and 2002. In addition, natural-origin sockeye salmon juveniles will be captured, enumerated, sampled, and released in a sockeye fry predation assessment study in Ozette Lake directed at piscine predators. Tributary-origin fry are proposed to be captured, enumerated, sampled, and released in a fyke net study to identify naturally spawning sockeye salmon productivity in Umbrella Creek. A rotary screw trap is planned for operation during the spring and early summer months in the upper Ozette River to identify total annual sockeye salmon smolt out-migrant production levels and timing. Additional monitoring and evaluation actions will include habitat and spawning ground surveys conducted for population census purposes, and to collect genetic, meristic, and morphological data from sockeye salmon spawners.

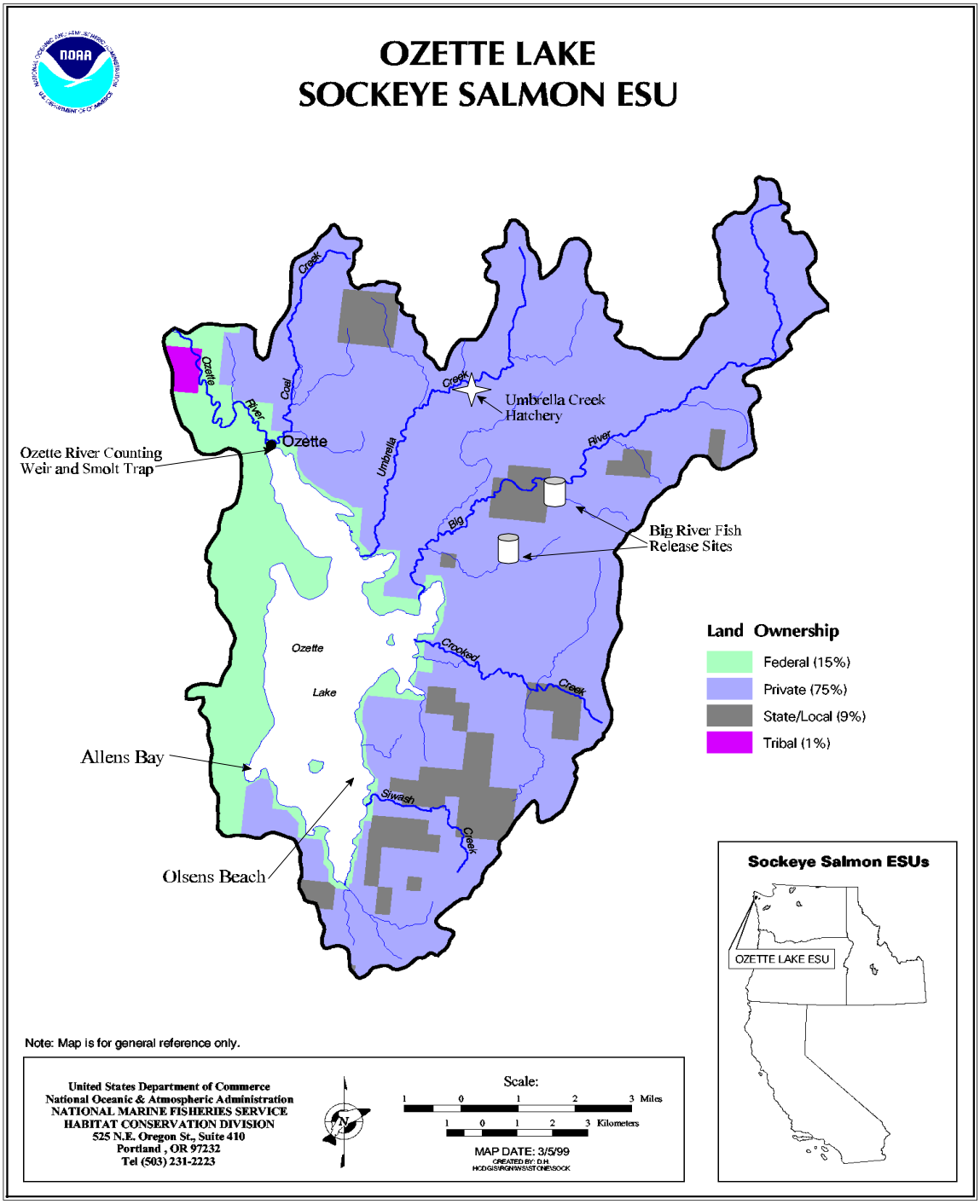
The HGMP's action area encompasses the entire Ozette Lake Sockeye Salmon ESU (Figure 1). The ESU includes all naturally spawned populations of sockeye salmon in Ozette Lake and its tributaries. All tribal and state artificial propagation, and associated research, and monitoring and evaluation actions currently proposed by the co-managers within the action area are included in the HGMP, and in NMFS' evaluation of the HGMP for approval.

The 4(d) Rule for the Ozette Lake sockeye salmon ESU states that the prohibitions of paragraph (a) of the Rule do not apply to activity associated with artificial propagation programs provided that criteria specified in 223.203(b)(5)(i) of the Rule are met. NMFS will approve an HGMP if it adequately addresses the following criteria specified in 5(i)(A) through 5(i)(K) of the 4(d) Rule for Ozette Lake sockeye salmon (65 FR 42422, July 10, 2000).

5(i)(A) The HGMP has clearly stated goals, performance objectives, and performance indicators that indicate the purpose of the program, its intended results, and measurements of its performance in meeting those results.

Goals, performance objectives (standards), and performance indicators for Ozette Lake sockeye salmon hatchery and associated research and monitoring and evaluation actions are stated in HGMP sections 1.6, 1.7, and 1.9, respectively (Makah 2000). From HGMP section 1.6, the intent of the supplementation portion of the program is "to prevent and reverse any potential decline of the ESU and to conserve the genetic and ecological characteristics of existing spawning

Figure 1. Location and geographic boundaries of the Ozette Lake Sockeye Salmon ESU.



aggregations of Lake Ozette sockeye salmon within the basin." The goal of the program as currently proposed is "to increase abundance of naturally spawning Ozette sockeye salmon to self-sustaining levels and to re-establish historic sockeye spawning abundance and distribution along the shore of Lake Ozette and its tributaries." This goal is pursued in the HGMP by establishing tributary-spawning sockeye salmon populations that are isolated from the listed beach-spawning sockeye population. The long term goal of the plan is to increase sockeye abundance to levels that will "meet future estimated escapement goals and culminate in sustainable fisheries" (Makah 2000) after the listed sockeye salmon ESU has been recovered.

The expected duration of the tributary hatchery program is 12 years, or three sockeye salmon generations, per release site. This HGMP will conclude in 2012, if re-establishment of each of the four year sockeye salmon classes required to provide viable, naturally-spawning, fully-seeded aggregations in the release areas has occurred. If the program is successful in establishing self-sustaining sockeye runs that meet determined escapement goals for release areas after 12 years of operation, it will be terminated. If the program, or a specific element of the program is determined to not be effective, it will be terminated. If, after 12 years, the program is meeting performance standards, and is expected to, but has not yet fully accomplished program goals, continuation of specific components of the program will be proposed and reevaluated. Similarly, if aspects of the program are not meeting goals or standards, but alternative adaptive management measures are available that are likely to achieve goals and standards providing a net benefit to the ESU, program elements may be changed and continued upon evaluation and reassessment before or after the 12-year evaluation. The co-managers' overall goals and objectives for the program will also be reevaluated over the duration of the hatchery programs to incorporate new findings. Tributary escapement goals and population abundance thresholds are yet to be developed by the co-managers and the TRT. The ability to meet minimum escapement and spawner distribution goals for release streams for each brood year will be considered in defining success or failure of the tributary program and its subsequent continuance or termination.

The hatchery program proposed in the HGMP is designed to test whether sockeye salmon can be established in tributary spawning habitat. The HGMP also includes research and monitoring and evaluation actions designed to benefit understanding of limiting factors to sockeye salmon productivity. The hatchery program and associated research actions are also designed to provide information on whether supplementation can potentially be used in the future to rebuild beach spawning aggregations, and to expand spawning in Ozette Lake to currently unused beaches (Makah 2000). However, the HGMP evaluated here is designed to isolate tributary artificial propagation efforts and effects from the listed beach spawning sockeye salmon aggregations. Work with beach spawning fish is limited to studies of limiting factors, genetic composition, and life history strategies. These studies will include the collection of a small number of sockeye salmon adults each year from lake spawning areas. Sockeye salmon broodstock will not be collected from any Ozette Lake beach spawning areas for tributary hatchery broodstock use. Adult returns to Ozette Lake tributaries (Umbrella and Crooked creeks) are the sole broodstock source for the hatchery program.

Performance standards for the plan are presented in HGMP Table 2. The standards are designed to enumerate intended results, to measure the program's success or failure in attaining those results, and to define actions necessary to identify factors for decline of the ESU. To summarize from Makah (2000), HGMP performance standards are:

1) provide current and historical sockeye salmon abundance estimates to improve conservation and (future) fisheries management capabilities;
2) assess and increase the natural productivity of Ozette Lake sockeye salmon by identifying limiting factors and conducting restoration actions;
3) conduct hatchery actions in a manner that maximizes hatchery-origin sockeye salmon benefits to the program and natural production;
4) identify, conserve, and increase the ecological and genetic diversity of Ozette Lake sockeye salmon;
5) conserve native fish populations in the Ozette Lake Basin;
6) adaptively manage the HGMP through integration of research and monitoring and evaluation findings into decision-making; and
7) fulfill Treaty rights through reestablishment of tribal fisheries (after recovery and de-listing).

Plan performance indicators are also presented in HGMP Table 2. From Makah (2000), the indicators are designed to determine the performance of the program in meeting fish production and stock recovery objectives, to gauge the effects of the program on listed natural-origin sockeye salmon, to monitor the status of the listed population, and to identify factors for decline of the ESU. Annual natural and hatchery-origin sockeye salmon population abundances are assessed by monitoring adult returns at counting weirs, in Ozette Lake, on spawning beaches, and in tributaries. Abundance data is evaluated to determine if the listed population is above minimum viable levels or above minimum escapement goals. The estimated contribution of hatchery-origin sockeye salmon to tributary and (as strays) beach-spawning areas is monitored by differentially marking (via otolith banding, and, for fed fry, adipose fin clip) hatchery-origin sockeye juveniles to allow for their distinction from natural-origin fish upon return as adults in Basin spawning areas. Weir censuses, lake surveys, and beach and tributary spawning ground surveys are conducted throughout the adult sockeye salmon return period to enumerate spawners, and to collect information regarding fish origin via mark observation and recovery, and age class composition through scale sampling. Using mark recovery information, the number of natural and hatchery-origin sockeye salmon contributing to annual escapement is estimated.

Indicators directed at assessment of natural sockeye salmon productivity include monitoring of natural origin recruit (NOR) adult abundances and trends through weir counts, beach and tributary spawning ground surveys, and lake surveys. Indicators of habitat-related factors limiting natural productivity include completion of a limiting factors analysis and monitoring of fish survival rates by life stage before and after restoration. Indicators of limits to natural productivity posed by pinniped and river otter predation include monitoring of species and numbers of pinnipeds and river otters preying on sockeye salmon, sockeye salmon scarring incidence in the Ozette River, and mortalities attributable to predation by life stage and habitat. Performance indicators directed at

hatchery productivity include assessment of broodstock collection, holding, and spawning results relative to standards, assessment of performance of the hatchery program in producing healthy fish, and assessment of post-release survival rates and the contribution of hatchery fish to NOR production in Ozette Lake tributaries.

Compliance with diversity-related performance standards is indicated through completion of genetic studies of sockeye and kokanee salmon populations in the Basin, regular genetic surveys and analysis of beach and tributary sockeye spawning aggregations, and annual tracking of sockeye population morphometric, meristic, and life history characteristics. The number and proportion of direct hatchery origin and NOR sockeye in tributaries and currently vacant beach spawning areas are additional diversity indicators. The number of tributary and beach spawning areas used by sockeye salmon, and their life history and morphological characteristics, are also indicators of compliance with diversity performance standards.

Information collected regarding native and introduced species abundance and diversity will indicate compliance with the community aquatic ecology standard. Development and implementation of monitoring plans, funding of research projects, publication of research and monitoring and evaluation results, and the establishment of a decision-making framework will indicate compliance with the adaptive management performance standard. When a viable Ozette Lake sockeye salmon population has been re-established, and after listed sockeye salmon recovery has occurred, the Treaty rights standard of tribal fisheries reestablishment will be indicated by fish harvest data, fishery duration, and fishery participation levels by tribal members.

5(i)(B) The HGMP utilizes the concepts of viable and critical salmonid population threshold, consistent with the concepts contained in the technical document entitled "Viable Salmonid Populations."

The regulations in the 4(d) Rule state that an HGMP must use the concepts of viable and critical thresholds as defined in the NMFS Viable Salmonid Population (VSP) document (NMFS 2000a). Application of these VSP concepts is needed to adequately limit the take of listed salmonids as broodstock to specified populations thresholds or circumstances for the protection of the species. Listed salmonids may be purposefully taken for broodstock purposes only if: the donor population is currently at or above the viable threshold and the collection will not impair its function; the donor population is not currently viable but the sole objective is to enhance the propagation or survival of the listed ESU; or the donor population is shown with a high degree of confidence to be above the critical threshold although not yet functioning at viable levels, and the collection will not appreciably slow attainment of viable status for that population.

Viable and critical population abundance thresholds have yet to be developed for Ozette Lake sockeye salmon. The Puget Sound and Olympic Peninsula Technical Recovery Team (TRT) for the Ozette Lake sockeye salmon ESU will derive a recovery goal for the ESU which may equate to a viable population abundance threshold. The Makah Tribe and WDFW have also not developed

Ozette Lake sockeye abundance or escapement thresholds on which to base stock recovery and management actions. The co-managers are currently focusing on estimating historical sockeye salmon run sizes and improving population census methods (e.g., counting weir video recording, lake hydroacoustic studies, and predation loss assessments) to provide more accurate population abundance parameters on which to base recovery goals and future critical and viable threshold determinations. In particular, further evaluations of harbor seal and river otter predation rates on migrating and lake-spawning adult sockeye salmon are needed. Recent studies indicate that predation rates by marine mammals may be an important limiting factor to the listed sockeye salmon population (NMFS 1997; Makah and NMFS MML 2000).

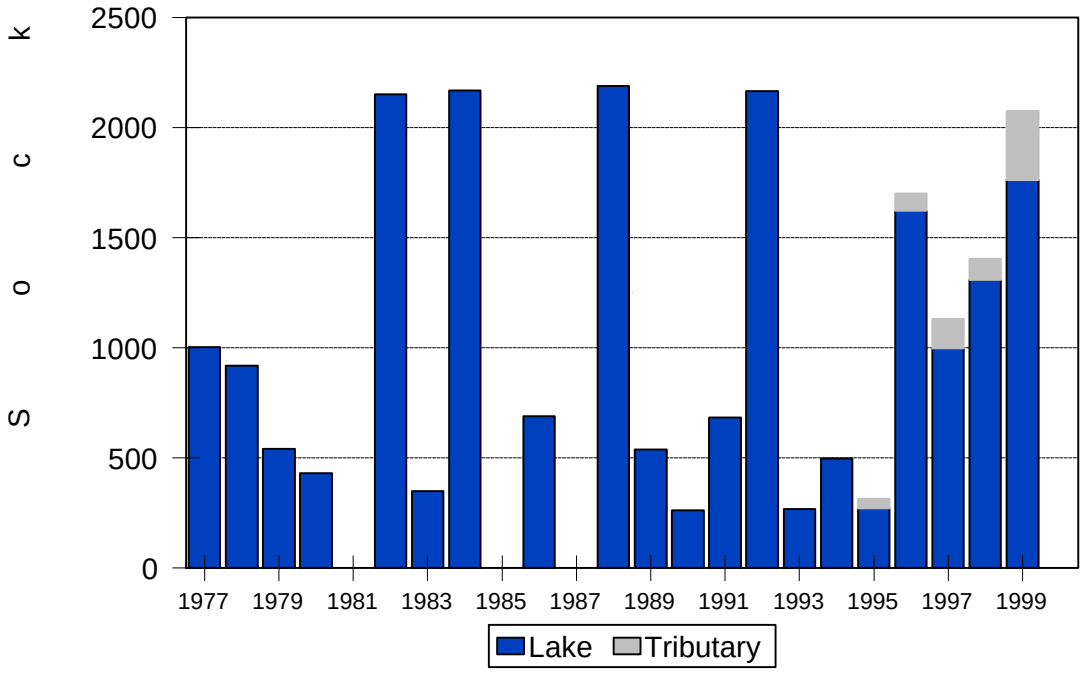
Provisional critical and viable population thresholds

Lacking TRT and co-manager determinations, for the purposes of evaluating this RMP, provisional critical and viable population thresholds for the Ozette Lake sockeye salmon ESU will be estimated. From the VSP paper (NMFS 2000a), the critical threshold will generally represent a state where a salmonid population is at relatively low abundance or productivity, and therefore at a relatively high risk of extinction in the near future. At the viable threshold, a population is functioning properly and at a self-sustaining abundance level, and has a negligible risk of extinction due to local factors. Derivation of these thresholds for abundance is based upon the specific ESU and historic information on population distribution and abundance. Guidance from the VSP paper suggests that effective population sizes of less than 500 to 5,000 per generation are at increased risk of extinction (NMFS 2000a). If the salmon population generation length is 4 years (the predominant generation length for Ozette Lake sockeye salmon (Makah, 2000)), the annual spawner abundance at the critical level would be in the range of 125 to 1,250 fish. At viable levels, abundance should range from 5,000 to 10,000 fish per generation, or (for fish with a 4 year generation length) 1,250 to 2,500 spawners per year. Viable population abundances in these ranges may not reflect actual, historical salmon abundance levels, which may be higher. If higher than the viable levels, achievement of historical abundances may not only be desirable, but biologically important from an ecosystem-wide perspective.

Population status relative to provisional thresholds

Estimates of annual adult sockeye salmon escapement into Ozette Lake are presented in Figure 2 (data from Makah, 2000). The annual proportions of sockeye salmon estimated to be of lake and tributary-origin are indicated. The 1977-99 average annual abundance level for the total Ozette Lake sockeye return was 1,075 (range 263 to 2,191; excludes 1981, 1985, and 1987 due to lack of data). The most recent four year annual mean run size from 1996 to 1999 for this predominately four-year-old age at return population was 1,598 adults (range 1,133 to 2,076; Makah 2000). This most recent four year mean escapement average compares to a mean escapement of 811 for the four previous years of the cycle (1992-1995, range $\leq$267 to 2,548). The 1996-99 mean lake escapements for beach-origin and tributary-origin sockeye were 1,424 and 156, respectively. Sockeye salmon originating from Ozette Lake tributaries (F1 hatchery and/or NORs) comprised an average of 9.8 % of the total escapement in recent years.

Figure 2. Estimated annual lake and tributary-origin adult sockeye salmon escapement levels into Ozette Lake for 1977 through 1999 (data from Makah, 2000).



The escapement data presented in Figure 2 consists of annual lake entry estimates for 1977 through 1999 derived from adult sockeye salmon counts at a weir located in the Ozette River at the outlet of Ozette Lake (from Makah 2000). Included in the figure are annual sockeye salmon run size estimates published in Jacobs et al. (1996) for the period 1988 to 1996 that were re-evaluated and adjusted based on actual daily count data by the Makah Tribe. Adult escapement estimates for 1998 and 1999 are based on video camera counts at the Ozette River weir. Video recording and counting first became available as a census technique in 1998. Return estimates for these years are considered to be reliable. The run size estimate for 1997 was adjusted by the Makah Tribe based on 1998 to 1999 video camera data results. The Makah Tribe did not upgrade or adjust run size estimates prior to 1997 based on new video camera data, mainly because methods used to enumerate adults varied from those applied in recent years, and because many of the data sets were either missing, incomplete, or very small. Adult sockeye abundance estimates for the years 1977 through 1996 are less reliable than estimates for the 1997 through 1999 return years. An analysis of potential errors and deficiencies in past run size estimation methods, and adjustments in previous return estimates made by the Makah Tribe, is presented in Makah (2000).

Although precise estimates of historical abundance were poorly documented and therefore unreliable, data and reports available prior to 1977 indicate that the overall abundance of the naturally-produced Ozette Lake sockeye salmon has probably declined substantially from historical levels. In the earliest quantitative estimate of abundance, Kemmerich (1945) estimated that the number of sockeye salmon entering the lake in 1924-1926 ranged from three to six thousand fish,

which is approximately twice the run sizes indicated in Figure 2. This historical range is likely conservative, as the estimates are likely based on sockeye salmon escapement data collected upstream from fisheries of unknown magnitude in, or in close proximity to, the Ozette River. In addition, Kemmerich (1945) did not enumerate fish during the early portion of the run, and published his findings 20 years after the data was collected. Dlugokenski et al. (1981) and Jacobs et al. (1996) used Makah Tribe sockeye salmon harvests verbally reported by local fish buyers for the three year period from 1949 to 1951 to indicate the potential, historical magnitude of the Ozette Lake run. Sockeye salmon harvests by the tribe during this period reportedly ranged from 14,500 to 17,700 fish. WDFW notes that their record of sockeye salmon harvests during the 1949 to 1951 period is based on these verbal reports only, and no paper documentation of actual fish landings by the Makah Tribe is available (Jeff Haymes, WDFW, pers. comm.). The fish buyer reports in the area were the first accounts of Ozette Lake sockeye salmon harvest. The lack of any harvest information prior to 1949 complicates the ability to evaluate the validity of the verbally reported estimates for 1949 through 1951. Dlugokenski et al. (1981), reported that, "catch data from 1948 through 1972 is extremely unreliable", and presented harvests estimates for the period in their document "to illustrate a general decline in harvest."

Preliminary harbor seal and river otter predation study observations (Makah 2000; NMFS 2000b), and actual sockeye salmon spawner census data for beach and tributary spawning areas (Makah 2000), indicate that pre-spawning sockeye salmon mortality during the lake-holding period prior to spawning (ranging up to nine months) is an important factor. Harbor seal predation on sockeye salmon in beach spawning areas appears to be significant (Makah and NMFS MML 2000; K.M. Hughes, Makah Tribe, pers. comm.) and sockeye salmon counts in beach and tributary areas have generally not accounted for the number of sockeye estimated to have entered the lake each year. Sockeye salmon census information collected as the fish enter Ozette Lake at the upper Ozette River counting weir may not accurately reflect actual spawner numbers for use in VSP threshold calculations. The need to gain further knowledge regarding actual spawning population sizes, and pre-spawning mortality levels, is acknowledged within the HGMP. To address these issues, substantial efforts are directed towards improving estimates of actual spawner population sizes and pre-spawning mortality levels in both beach spawning and tributary areas. These efforts include:

- improved census techniques at the Ozette River fish counting weir;
- radio tagging and hydroacoustic studies to identify sockeye salmon behavior, pre-spawning mortality rates, and spawning locations in Ozette Lake;
- continued harbor seal predation observations at beach spawning locations;
- expanded beach and tributary spawner census and mark recovery surveys (snorkel, boat, foot, and plane) to count beach and tributary spawners and identify their origin;
- mass marking of sockeye salmon produced in the hatchery program to allow for their differentiation from natural-origin sockeye during spawning; and,
- installation of an adult fish counting weir on Umbrella Creek to more accurately count spawners in that tributary.

Pending results from studies to improve actual spawner abundance estimates, and to be appropriately conservative, it should be assumed that the Ozette River weir count estimates overestimate the actual number of successful spawners. Without taking into account any pre-spawning mortality, the revised escapement estimates provided by the Makah Tribe would indicate that recent year average abundance for the listed beach-spawning sockeye salmon population (1,424) was above the VSP document-based generic critical annual spawner abundance level range (125 to 1,250 fish), and just within the approximate generic viable annual spawner range (1,250 to 2,500 fish). Inclusion of NORs resulting from the HGMP's tributary hatchery program in the average listed fish escapement estimate would increase the escapement average used for VSP range comparisons slightly. The Makah Tribe estimates that 37.2% of the 312 adult sockeye salmon spawning in Umbrella Creek in 1999 (116 fish) were NORs, and therefore listed. However, the results of studies identifying pre-spawning sockeye salmon mortality levels, and actual spawner levels on beach spawning areas and in the tributaries, are needed before any conclusions can be reached regarding the population viability status of the Ozette Lake sockeye salmon ESU. The results from these studies will benefit the ability of the co-managers, NMFS, and the TRT in making sockeye salmon population viability determinations.

For the interim period, the HGMP, and complimentary habitat conservation measures implemented by Federal, state and private land managers in the Ozette Lake Basin (such as forest practice regulations adopted and implemented by the Washington Forest Practices Board), are expected to result in a positive trend toward recovery. These measures are necessary and justified, even if the recovery goal for the Ozette Lake sockeye population has not yet been established. The results of research and monitoring and evaluation measures proposed in the HGMP will also improve scientific understanding of the abundance status and genetic, life history and ecological characteristics of the listed population, and of factors limiting productivity. This new information will improve prospects for the application of appropriate management measures for recovering the listed population. In addition, performance indicators described in the HGMP require determination of the performance of the program in preserving and increasing the abundance of naturally spawning sockeye salmon in beach and tributary areas, and in maintaining the genetic and ecological characteristics of the listed beach-spawning population. Performance measures and indicators included in the HGMP (sections 1.0 and 11.0) allow for adaptive management of the program. Based on new information collected through research and monitoring and evaluation, the hatchery program will be adjusted as necessary (e.g., changes in imprinting methods or in fish release numbers or practices) to improve its performance, or to reduce any adverse effects on natural-origin sockeye salmon. The program will also be adjusted if it is not assisting in increasing self-sustaining sockeye abundance, in preserving population structure and diversity, or if the program is no longer needed to effectuate recovery.

Broodstock collection compliance with 4(d) Rule population threshold criteria

The hatchery program described in the HGMP relies on broodstock removed from Ozette Lake tributary sockeye salmon returns. The listed beach spawning population will not be used as broodstock. Sufficient sockeye adult returns, both first generation hatchery fish and NORs, are now returning to Umbrella Creek, augmented by returns to Crooked Creek, to sustain the tributary

hatchery program. Adult sockeye salmon returns to these tributaries result directly from hatchery juvenile sockeye salmon releases, or from natural spawning in Umbrella Creek by hatchery-origin adult sockeye salmon. NOR sockeye salmon returns to the tributaries created by the program are considered listed. The core, listed beach-spawning population is proposed to be collected in low numbers, for research purposes only. Avoidance of collection of the core listed sockeye population as broodstock for the hatchery portion of the HGMP is consistent with criteria specified in the Rule under 5(i)(B) to protect listed fish. Future determinations regarding whether sockeye broodstock are collected from Ozette Lake beaches to supplement or reintroduce lake aggregations will be made pending results of limiting factors evaluations and research. Only when it has been determined that hatchery supplementation efforts will likely aid recovery of the lake sockeye population, and that a successful method of supplementation exists, will the lake aggregations be considered for use in lake supplementation and/or reintroduction measures.

As allowed in the 4(d) Rule, listed *tributary-origin* NOR sockeye salmon are taken as broodstock through the HGMP for the sole purpose of enhancing the propagation or survival of the listed naturally producing tributary sockeye salmon aggregations. This HGMP does not propose or analyze the production of the progeny of sockeye salmon broodstock collected through the hatchery program for harvest in fisheries. Increasing sockeye salmon abundance to allow sustainable fisheries is a long term objective of the co-managers, but future initiation of fisheries will be dependent on recovery of the listed sockeye population. Any proposal for the use of broodstock to produce fish for harvest will require reevaluation of the HGMP by NMFS. The sole objective of the current program under ESA review is sockeye salmon conservation.

As noted in NMFS' sockeye salmon status review (Gustafson et al. 1997), and in the Federal Register Notice announcing the ESA listing of the Ozette Lake Sockeye Salmon ESU (FR 64 14528, March 25, 1999), habitat in the Ozette Lake watershed is considered degraded. Land use on private and state lands in the watershed is principally devoted to forest practices. Outside of that portion of the Ozette Lake Basin that is included in the Olympic National Park, virtually the entire watershed has been logged. Among the changes attributable to past forest practices (including intensive logging, wood removal in Ozette Lake tributaries, and associated road building in the watershed prior to state regulation of forest practices) is degradation through siltation of key streams, tributary outwash fans, and beach areas historically used by sockeye salmon. The increased sediment load in the tributaries, with settling of much of the finer sediment in the lake, likely limited what was a more widespread sockeye salmon spawning distribution in the lake and the tributaries to a few, less affected beach areas on the south end of Ozette Lake (WDFW and WWTIT 1994). Dlugokenski et al. (1981) suspected that logging-induced sedimentation led to decreased hatching success of sockeye salmon in the tributary creeks and creek outwash fans in Ozette Lake. Recent data collected by the Makah Tribe indicates high levels of fine sediment (<0.85 mm) within spawning gravels of Ozette Lake tributaries, averaging 17.1% of core samples (Makah Fish Management (MFM), unpublished data). Sediments smaller than 0.85 mm in concentrations greater than 11% (by volume) have been found to decrease survival of salmonid eggs and alevins within gravels (Peterson et al. 1992). McHenry et al. (1994) found that fine

sediments (<0.85 mm) at concentrations >13% resulted in intragravel mortality of salmonid embryos due to oxygen stress and metabolic waste build-up.

Sedimentation of key portions of lake tributaries, spawning beaches, and outwash fans as a result of timber harvest and road building may not have caused the declining sockeye salmon abundance, but has contributed to the failure of Ozette Lake sockeye salmon populations to rebuild since the cessation of commercial sockeye salmon harvests in the region in 1974 (FR 64 14528, March 25, 1999). No Ozette Lake sockeye salmon fisheries harvest has occurred since 1982. In addition to increased sediment loads, past forest practices in the major Ozette Lake tributaries that also contributed to channel instability (as indicated by stream widening and shallowing), cementing of spawning gravels, loss of pools, bank erosion, and high water temperatures have likely limited sockeye salmon productivity (WDF and WWTIT 1994). Furthermore, the removal of logjams from the Ozette and Big rivers in the 1950s (Kramer 1953) likely affected the quality and quantity of spawning and incubation habitat available to beach spawning sockeye in Ozette Lake. Improvement in habitat conditions is essential for the HGMP to successfully assist in the recovery of Ozette Lake sockeye salmon population abundance, productivity, diversity, and distribution in lake and tributary production areas.

NMFS' VSP document describes four key parameters for evaluating the status of salmonid populations (NMFS 2000a). These parameters are: 1) population size (abundance); 2) population growth rate (productivity); 3) spatial structure; and 4) diversity. Below is an evaluation of how the HGMP adequately addresses these VSP parameters for the Ozette Lake sockeye salmon ESU.

1.) Population Size

As mentioned above, VSP concept-based critical and viable population thresholds for the listed Ozette Lake sockeye salmon ESU have yet to be identified and an annual spawning escapement goal to meet production objectives in Ozette Lake has not yet been established. The co-managers have re-evaluated historical escapement data, and methods applied to expand the data, to estimate total annual run sizes and to derive improved annual freshwater run size (abundance) estimates for the ESU. The co-managers have also revised population census techniques at the upper Ozette River adult salmon counting weir to improve the accuracy of total annual abundance estimates for sockeye entering Ozette Lake. Spawner abundance surveys, mark sampling, marked fish recovery and observation programs directed at juvenile and adult sockeye (all hatchery fish are marked), hydroacoustic and sonic tagging studies, and adult sockeye counts in Umbrella Creek using a new weir, are also proposed as means to determine beach and hatchery tributary population (either NOR, or direct hatchery-origin, hereafter referred to as "F1") contributions to annual escapements. Included in these studies to assess F1 hatchery fish stray levels are snorkel and boat surveys of beach spawning areas to: enumerate spawners; observe and recover any marked hatchery-origin fish; and collect otoliths from carcasses.

There may be considerable differences in physical and biological conditions between beach and tributary spawning areas in the Ozette Lake Basin. These differences may include daily and

seasonal water temperature regimes, salinity, chemical components, nutrient loading, and productive status of the water systems. When otoliths form in developing sockeye salmon, the otoliths will "lock in" and reflect specific water and trophic conditions of the different ambient environments as revealed by oxygen and carbon isotope ratios, respectively. If feasible through analysis of stable isotope ratios of salmon otoliths from different beach and tributary spawning areas, NOR tributary sockeye straying to beach areas could then be assessed.

The listed Ozette Lake sockeye salmon ESU includes all naturally spawned populations belonging to the species' anadromous life form residing below impassable natural barriers (FR 64 14528, March 25, 1999). To briefly summarize key life history characteristics, adult Ozette Lake sockeye salmon enter freshwater from April to early August, holding three to nine months in Ozette Lake prior to spawning in late October through January. Eggs and alevins remain in gravel redds until the fish emerge as fry in spring. Fry then migrate immediately to the limnetic zone in Ozette Lake, where the fish rear. After one year of rearing, in late spring, Ozette Lake sockeye salmon emigrate seaward as age-1+ smolts. The majority of Ozette Lake sockeye salmon return to spawn as four year old adult fish, having spent one winter in freshwater and two winters at sea.

The core, listed beach-spawning sockeye salmon populations are known to occur at Allen's Bay and Olsen's Beach (Figure 1). The sockeye salmon stock propagated at Umbrella Creek Hatchery for the tributary stocking program described in the HGMP is considered part of the Ozette Lake sockeye salmon ESU. This determination was made based on the fact that Umbrella Creek broodstock were derived from the wild beach-spawning population. The tributary hatchery program is now sustained by broodstock removed from NOR and F1 adult sockeye salmon returns to Umbrella Creek, and possibly in the short term, by F1 returns to Crooked Creek. Spawning ground census information collected since the 1970s suggests that straying of beach spawning sockeye adults to Ozette Lake tributaries is unlikely, and beach-origin fish are not at risk of removal through broodstock collection proposed in the HGMP. At the time of ESA listing, and based on the presence of significant numbers of sockeye salmon still spawning naturally on Olsen's Beach and in Allen's Bay in Ozette Lake, NMFS concluded that the Umbrella Creek Hatchery stock is not essential for recovery of the ESU. The co-managers notified NMFS during the listing determination process that the hatchery stock was important for sustaining the sockeye population in Ozette Lake from which the hatchery stock was directly derived, and that it should be considered essential for recovery (WDFW 1998; Makah 1998). The NMFS "not essential" determination does not preclude the hatchery population from future use in recovery if conditions warrant (e.g., if the natural beach-spawning population became extinct or at high risk of extinction.) The hatchery population may therefore be considered a reserve gene pool for listed sockeye salmon recovery. For the present time, NMFS determined that it is not necessary to consider the progeny of intentional hatchery-wild or wild-wild sockeye salmon crosses as listed (FR 64 14528, March 25, 1999). However, tributary-origin adult sockeye that are progeny of naturally spawning fish are listed, and may be included in listed sockeye recovery abundance censuses.

The two known, principal shoreline spawning beaches used by the listed sockeye salmon population in Ozette Lake are Olsen's Beach, north of Siwash Creek on the lake's eastern shore and the beach area north of Allen's Bay, on the lake's western shore (WDF and WWTIT 1994). Mature adult sockeye salmon in Ozette Lake have also been reported near the south shore of Baby Island at the southern end of the lake, in Ericson's Bay (Gustafson et al. 1997 quoting Jacobs et al. 1996), and near Umbrella Creek (WDF and WWTIT 1994; Jacobs et al. 1996). The co-managers are conducting studies through the proposed HGMP to determine if additional beach locations are used by sockeye salmon in the lake.

WDFW, the Makah Tribe, and an independent group of fisheries biologists assembled to review the Ozette Lake sockeye salmon population believe that Ozette Lake sockeye salmon historically spawned in tributaries to Ozette Lake, potentially including Big River, Umbrella Creek, Crooked Creek, and in the Ozette River (WDF and WWTIT 1994; Makah 2000; consensus conclusions in Jacobs et al. 1996). However, some fisheries biologists who have examined available spawning data question whether sockeye salmon historically occurred in Ozette Lake tributaries (individual scientist opinions in Jacobs et al. 1996; Gustafson 1999; NPS 2000). Spawning sockeye salmon have been absent from Ozette Lake tributaries in recent decades. Available information on historic spawner abundance, timing, and distribution in Ozette Lake tributaries prior to that time is unclear, anecdotal, and often contradictory. The issue of whether or not sockeye salmon existed in Ozette Lake tributaries is discussed in several documents provided to NMFS during the pre-submittal technical review process for the HGMP (NPS 2000; MFM 2000). In response to National Park Service comments (NPS 2000), the Makah Tribe modified the HGMP to include a more detailed treatment of the issue of historic sockeye salmon spawning distribution in the Ozette Lake tributaries, and factors that may have affected their presence or absence (Makah 2000).

The question of whether or not self-sustaining sockeye salmon populations existed in the tributaries remains unresolved, and is likely unanswerable due to the lack of conclusive evidence regarding historical sockeye spawning distribution. At present, the Makah Tribe's sockeye salmon hatchery program has seeded Umbrella Creek, leading to relatively large natural spawning abundances in that tributary. Adult returns to Umbrella Creek have ranged from 44 (1995) to 312 (1999) fish, and exceeded 2,500 adult sockeye salmon in 2000 (M. Crewson, Makah Tribe, pers. comm.). In 1999, 37.2% of the total adult escapement to Umbrella Creek was estimated to be the progeny of naturally spawning tributary fish (Makah 2000). As mentioned above, all NOR sockeye salmon originating from the tributaries are listed under the ESA (FR 64 14528, March 25, 1999).

This section of the 4(d) Rule allows for the purposeful take of populations if the donor population is shown with a high degree of confidence to be above the critical population threshold although not functioning at viable levels, and the collection will not appreciably slow the attainment of viable status for the population. Under the proposed program, the listed lake-spawning Ozette Lake sockeye population is not used as a source of broodstock to sustain the tributary hatchery programs. From the HGMP, sockeye salmon broodstock will only be collected and spawned from returns to Umbrella Creek (and possibly from Crooked Creek in return years 2000 through 2002, if

any adults can be found and captured), to assist in the initiation of self-sustaining sockeye salmon returns in Ozette Lake tributaries. Proposed tributary hatchery broodstock collection actions will therefore not diminish the abundance or affect the present viability status of the lake spawning population. The proposed broodstock collection program will also not appreciably slow attainment of a viable status for the listed ESU. A limited number of adult sockeye salmon (up to 10 fish) are collected from the lake spawning areas for use in juvenile sockeye beach survival and egg planting method research. The removal of this low number of adult fish relative to the average lake spawner abundance (recent year average of 1,424) for research purposes only is not likely to affect prospects for recovery of the listed ESU. These research removals represent <1% of the listed population, which has shown an increased abundance in recent years. Given that NORs resulting from the tributary hatchery program adult returns are listed, the successful establishment of NOR-based tributary populations would increase the total abundance of naturally produced sockeye salmon in the ESU, and therefore may assist in recovery of the population to viable levels, pending TRT determinations.

The proposed annual collection of up to 200 sockeye salmon adults from Umbrella Creek (and Crooked Creek) will lead to the production of approximately 80,000 unfed and fed sockeye fry for release into Umbrella Creek and 139,000 eyed eggs for incubation, and eventual release of unfed and fed fry into Big River. Assuming an average eyed egg to fry survival rate of 97%, the program on Big River may lead to the release of 133,000 unfed and fed sockeye fry. Applying an estimated fry to returning adult survival rate of 0.6% from the HGMP to the total fry releases at the two locations, beginning in 2004, 480 F1 adult sockeye may return to Umbrella Creek and 798 F1 adults may return to Big River each year as a result of tributary hatchery program juvenile sockeye releases. Additional NOR adult fish will return to the tributaries concurrently with these F1 adult sockeye.

Until the adult to adult replacement rate for natural-origin sockeye is greater than 1.10 (the Makah Tribe anticipates that it will take 6-8 years of data collection in order to calculate spawner-replacement rates), the number of sockeye salmon collected as broodstock in Umbrella Creek for supplementation of Umbrella Creek is proposed to be limited to no more than 40 adult pairs. This number was selected to minimize depression of the inbreeding effective size of the spawning aggregation (Ryman and Laikre 1991), while exposing genetically diverse fish to natural selection in the target environment (Nicholas 1980). After a replacement rate of 1.10 has been achieved, the number of adults collected as broodstock for supplementation of Umbrella Creek will be limited to no more than 15% of the Umbrella Creek run size, or 40 pairs of fish, whichever is smaller. This approach is designed to: optimize the number of fish exposed to natural selection in the target environment; minimize potential decreases in local adaptation that may result from removing fish from the natural environment; minimize the risk of domestication effects; and minimize the number of fish exposed to the risk of catastrophic hatchery failure.

For the first two to three generations, total broodstock removals for the Big River hatchery program will be limited to no more than an additional 60 pairs or a combined (both hatchery

programs) 15% removal from the total Umbrella Creek adult return each year, whichever is lower. This approach also allows for growth of natural spawning aggregations in Umbrella Creek

For 2001-2003, a portion of the 200 fish needed as broodstock might be collected from Crooked Creek, providing additional adult fish for natural production in Umbrella Creek. Extremely low flows in Umbrella Creek at the time of hatchery fry releases in 1998, very small fish release numbers in 1999 (27,385 fingerlings), and no fish releases into Umbrella Creek in 2000 will likely lead to reduced adult sockeye salmon returns to the tributary for the 2001, 2002 and 2003 return years (M. Crewson and M. Haggerty, Makah Tribe, pers. comm.; Makah 2000). The proportion of escaping adult fish removed as broodstock from Umbrella Creek in these initial years of the program may therefore be greater than 15%, but may not exceed 40 pairs.

Naturally spawning returns to the Ozette Lake tributaries (specifically Umbrella Creek and in later years, Big River) resulting from the hatchery juvenile sockeye releases are assisting in the creation of NORs in the tributaries. Of the 138 sockeye salmon spawners per mile observed in Umbrella Creek in 1999, the Makah Tribe estimates that 37.2% were NORs, yielding an estimated adult replacement rate for natural spawners of 2.7 (Makah 2000). Although evidenced by only one year of data, the advent of a large number of NORs may indicate that life history traits of the original donor, lake-spawning sockeye stocks are compatible with, and may have adapted to, Ozette Lake tributary habitat conditions. Based on available tributary spawning habitat, the abundance of listed fish in the ESU is expected to increase if self-sustaining populations are established at full habitat seeding levels in the tributaries as a result of the proposed hatchery program. Results for 1999 indicate that NOR tributary spawners established through the hatchery program have the potential to become self-sustaining. However, determinations of whether self-sustaining sockeye aggregations have been successfully established in the tributaries must rely on stock recruitment data collected through the HGMP over several sockeye generations.

The abundance status of the listed lake spawning population that is the focus of the NMFS ESA listing decision will not be directly enhanced as a result of the HGMP. The lake spawning population will also not be affected by broodstock collection proposed for the tributary hatchery program through the HGMP. By producing NOR adult returns to Basin tributaries in excess of beach spawning population levels, the HGMP is expected to produce a stable or increasing trend in escapement and abundance until extant populations for recovery (including the standing of NOR tributary sockeye in recovery considerations), and a viable abundance threshold for the Ozette Lake sockeye salmon ESU, are identified by the TRT. HGMP-implemented research of limiting factors affecting the lake spawning population, and identification of habitat restoration strategies by the co-managers, may help guide TRT recovery decisions for the listed ESU.

The tributary sockeye salmon aggregation propagated under the HGMP is not essential for recovery, but if conditions warrant, the stock is not precluded from playing a role in recovery (FR 64 14528, March 25, 1999). The listing decision established the legal status of the existing hatchery population only, and does not preclude use of aggregations created through hatchery supplementation as essential parts of future, formal Ozette Lake Sockeye Salmon ESU recovery

efforts. Pending TRT sockeye salmon recovery determinations, establishment of sockeye salmon populations in the tributaries may be considered a genetic reserve for the listed stock. Sockeye salmon returns established through the hatchery program in the tributaries originated from the listed beach spawning population, and are only one generation removed (for use in artificial propagation) from that population. Establishment and maintenance of tributary aggregations decreases the risk that Ozette Lake sockeye salmon will be lost in the event of extinction, or catastrophic conditions causing a high risk of extinction, for the beach spawning population. However, regardless of the ESA standing of tributary sockeye aggregations established through the HGMP, recovery of the ESU will still require a self-sustaining, viable beach-spawning sockeye salmon population.

The HGMP includes very comprehensive monitoring and evaluation and research components, described in HGMP sections 10 and 11, respectively. In the period prior to TRT determinations, these monitoring and evaluation and research activities are expected to help identify the abundance status of the listed sockeye salmon population with a higher degree of confidence. These activities are also expected to improve scientific understanding of factors that have contributed to the decline of the lake population, and factors presently limiting or threatening beach spawner abundance. Monitoring and evaluation actions proposed in the HGMP that are expected to benefit lake spawning population abundance recovery efforts are:

1) identification, through hatchery fish mass marking and mark observation/recovery programs, of the proportions of hatchery and natural-origin adult sockeye salmon entering the lake and spawning in natural spawning areas, including beaches;
2) monitoring of ecological interactions between hatchery-origin sockeye salmon and natural-origin sockeye salmon;
3) monitoring through radio tagging and hydroacoustic surveys, of adult sockeye behavior during migration and spawning, and identification of the locations of spawning in Ozette Lake;
4) identification of the genetic characteristics of lake and tributary sockeye populations and of Ozette Lake kokanee populations; and
5) monitoring of the number and migration timing of sockeye salmon adults entering Umbrella Creek and smolts emigrating in the Ozette River.

Research actions that are designed to benefit listed sockeye recovery are:

1) study of harbor seal and river otter predation on adult sockeye salmon in the Ozette Lake Basin (radio tagging and predation observation research);
2) enumeration and identification of hatchery and natural-origin sockeye adult proportions of adult fish migrating past the Ozette River counting weir;
3) studies of egg and fry survival and predation loss rates on lake beaches;
4) habitat surveys to identify the location and condition of extant beach spawning areas in Ozette Lake; and
5) spawning ground surveys to enumerate sockeye salmon spawning abundances in beach and tributary areas.

In addition to the above proposed research actions, the Makah Tribe intends to conduct a multi-phase research project to examine how the removal of 26 full-spanning logjams from the Ozette and Big Rivers in the early 1950s (Kramer 1953) may have affected lake level, fluctuations in lake level, and subsequently, the quantity and quality of salmon spawning and incubation habitat. This project will be accomplished by developing approaches for modeling the hydrological characteristics of the logjams, and modeling river, lake, and watershed hydrological characteristics. The results of this research may be used to indicate the role of logjam removal in the Basin as a factor for decline in the abundance of Ozette Lake sockeye salmon.

2.) Population growth rate

Because reliable data do not currently exist on historic abundance and distribution, spawner/recruit or smolt per adult functions for use in evaluating stock-specific population growth rates and estimating the productivity of Ozette Lake sockeye salmon have not been developed. The collection of appropriate adult and emigrating smolt abundance and adult age class at return data for deriving listed sockeye salmon survival rates is called for in the HGMP (sections 10 and 11). Estimates of the total annual adult return abundance (i.e., the population entering Ozette Lake) are provided through improved census techniques (video recording and mark observations) at the Ozette River counting weir. Lake and tributary spawning area surveys, and seal and otter predation study results, will improve realized spawner abundance estimates for comparison to estimates of the total run entering the lake. Sockeye salmon carcasses in beach and tributary areas are sampled for scales and marks (otoliths and fin clips) to determine age structure and hatchery versus natural-origin. Natural-origin fry production in Umbrella Creek will be monitored through fyke netting to determine tributary spawner production success, if deemed appropriate. Survival and predation studies of sockeye eggs planted through the research project on Olsen's Beach will improve knowledge of beach spawner sockeye productivity. The collection and sampling of potential sockeye fry predators in the lake using beach seines will assist in determinations of predation effects on fry survival. A smolt enumeration program is also proposed in the HGMP through operation of a rotary screw trap in the upper Ozette River during the sockeye salmon smolt emigration period. Smolt count and mark observation data collected through smolt trapping will allow estimation of the productivity of lake and tributary spawners.

An updated NMFS analysis of Ozette Lake sockeye salmon abundance trends (based on run size data presented in Jacobs et al. 1996) indicates that the long term (1977-98) population abundance trend for Ozette Lake sockeye, expressed as average percent annual change, was -2.0 (NMFS 1998). The current tributary-based hatchery program was planned and initiated in response to the long term, declining population trends identified for the Ozette Lake sockeye salmon population. The updated analysis also indicated that the most recent ten year (1989-98) trend has improved from a decline of 9.9% per year (as reported in Gustafson et al. 1997) to an increase of 2% per year (NMFS 1998). From the NMFS VSP document, a spawner to spawner ratio of greater than 1 to 1, as may be indicated by slightly increasing abundance trend for Ozette Lake sockeye salmon, is one criterion necessary for population viability (NMFS 2000a).

Trends in historic abundance were analyzed by the Makah Tribe, after evaluating and adjusting run size estimates from 1988 to 1996 previously provided by Jacobs et al. (1996). These adjusted run size estimates, and evaluation of complete sets of hard data from recent camera and visual weir counts, suggest (as per NMFS 1998) a stable or increasing trend in recent sockeye salmon escapements to the lake (Makah 2000) (see Figure 2). In reaching this conclusion, the Tribe noted, however, the need to take into account problems with examining trends among historical run size data recorded for Ozette Lake sockeye salmon due to different run size estimation methods applied among years. More accurate estimates of trends in overall abundance and productivity can be determined in the future using new underwater video camera adult sockeye salmon census methods at the Ozette River weir.

The tributary sockeye hatchery program described in the HGMP is designed to colonize Ozette Lake tributaries with self-sustaining sockeye populations. Preliminary data indicates that the program has been successful in producing natural-origin adult sockeye returns, although the long term success of the program in creating self-sustaining populations is still uncertain. Peak adult sockeye salmon observations in Umbrella Creek in 1995 were 19 fish per mile. Peak counts in 1999 were 138 adults per mile (Makah 2000). Of the 138 spawners per mile observed in Umbrella Creek in 1999, it is estimated that 37.2 % (52/138) were natural origin recruits, yielding an adult replacement rate of 2.7 (Table 1; Makah 2000). This tributary NOR spawner to adult return rate compares favorably to flat or slightly increasing (greater than 1.0) replacement rates evident in recent years for the listed beach spawning aggregations (see Figure 2 for review of four year cycle returns). For comparison, Foerster (1968) reported a 28 year (1921-48) average adult return per spawner rate of 1.8 for Karluk Lake, Alaska wild-origin sockeye salmon. Roos (1991) estimated that Fraser River sockeye salmon exhibit an average return per spawner rate of 4.4.

Table 1. Peak adult sockeye salmon counts from Umbrella Creek (RM 2.5 to 4.8) (Makah 2000).

Return Year	Hatchery Releases[1]	Adult Sockeye	Distance (miles)	Peak Fish/Mile	Peak Number NOR/Mile
1995	48,186[2]	44	2.26	19	na
1996	No Release	79	2.26	35	35
1997	39,040[3]	135	2.26	60	na
1998	44,411[3]	96	2.26	42[5]	na
1999	45,220[4]	312	2.26	138	52

[1] Hatchery releases correspond to return years, not release years, which were 3 years prior to adult returns.

[2] 48,186 fingerlings were the combined lake and creek releases of which 7,645 were released into Umbrella Creek.

[3] Lake release only.

[4] All fish were released into Umbrella Creek.

5 Surveys did not include the peak spawn timing due to excessive turbidity.

NORs resulting from the tributary colonization program may contribute to the overall productivity of the listed ESU by using spawning habitat that is not being colonized naturally by lake spawning fish. Productivity of the tributary spawning populations (measured as egressing fry/fingerlings per year) may increase until suitable habitat in Umbrella Creek and Big Creek (the two tributaries

targeted for hatchery release) is fully colonized, and if resultant sockeye broods become more adapted to the tributary environments. If productivity conditions in Ozette Lake are not limiting at current lake spawner juvenile fish production levels (as suggested by Beauchamp et al. 1995), natural-origin juvenile fish entering the lake from the tributaries will lead to increased smolt numbers and, if ocean conditions are not limiting, increased natural-origin sockeye adult returns. The relationship of the HGMP artificial propagation program to sockeye salmon productivity and juvenile fish carrying capacity in Ozette Lake is further addressed in the "Ecological Effects" discussion (page 38) of this document.

The HGMP includes monitoring and evaluation and research activities that will improve scientific understanding of the productivity of the listed sockeye population, and the effects of the HGMP hatchery program on lake spawner productivity. These actions are listed above in the section addressing population size factors.

3.) Spatial structure

The intent of the HGMP is to maintain the source lake spawning sockeye salmon aggregations at their present, known locations (Olsen's Beach and Allen's Bay), managing them as distinct segments of the listed ESU. Although spawning counts have been conducted in lake tributary areas, the number and distribution of spawners among Ozette Lake beach spawning areas are unknown. Scuba, snorkel, and boat surveys of known beach spawning areas in Ozette Lake have thus far been unsuccessful in accounting for the number of sockeye salmon estimated to have entered the lake. The results of these surveys suggest the existence of other beach spawning areas that are yet to be identified, or high pre-spawning mortality rates during the three to nine month lake holding period. Monitoring and evaluation and research actions proposed in the HGMP (adult sockeye salmon radio tagging and hydroacoustic surveys, genetic studies, and spawning area surveys) will improve scientific understanding of the population structure and spawning distribution of the listed population. In addition, habitat and radio-tagging surveys proposed in the HGMP will help identify predation impacts on adult sockeye salmon holding in the lake and the location and condition of critical lake spawning areas that need to be maintained to preserve the population structure of the listed Ozette Lake sockeye salmon ESU.

The HGMP ends past practices of collecting broodstock for the tributary hatchery program from the lake spawning populations. Broodstock are procured from tributary sockeye returns, and the population structure of extant lake spawning sockeye will not be affected by collection. Removal of lake spawning fish is limited to 10 sockeye adults for use in studies designed to assess the suitability of beach spawning areas for sockeye egg and fry production. The suitability and potential use of hatchery methods for enhancing beach-spawning sockeye production (e.g., planting of eyed eggs in Jordan-style incubators) will also be assessed through these studies. Further research program effects on the lake spawning populations are confined to capture, handling, and release studies for stock assessment, biological sampling and genetic analysis purposes. Fewer than 16 adult sockeye salmon and 470 juvenile sockeye salmon may be inadvertently killed through these studies. These latter loss estimates are totals, including natural

(beach and tributary-origin) and hatchery (F1 hatchery-origin) fish. Actual unintentional mortalities to beach spawning fish through the studies will not exceed these levels and may well be less.

The HGMP includes measures to limit and monitor straying of hatchery-origin sockeye to lake spawning areas to preserve spatial structure of the listed population. Hatchery-origin sockeye produced through the HGMP are imprinted to, and released within, two Ozette Lake tributaries. Available data indicate that adult returns resulting from tributary releases have a low tendency to stray to lake spawning areas. No straying to lake beaches was observed for either the 1999 or 2000 adult return years. In 2000, approximately 4,400 adults returned to Lake Ozette, and more than half returned to Umbrella Creek (MFM unpublished data). Of 179,273 sockeye salmon juveniles released from the parent 1996 brood year for the 2000 adult return, 69,273 (38.6%) were adipose fin clipped. Despite this proportion of marked fish, and relatively low tributary flow rates during the adult return period that might foster straying to locations in the Basin other than the tributary release site, no clipped fish were found on lake beaches in 2000. More than 200 adult carcasses were sampled for fin clips on the beaches that year (MFM unpublished data). Similarly in 1999, no straying was observed to lake beaches (0 out of 121 lake spawners sampled were marked with an adipose fin clip) out of 400 adult spawners that returned to Umbrella Creek. Juvenile sockeye salmon from these brood years were directly released into Umbrella Creek from the facility. The 1999 and 2000 return years are the only years where marked hatchery-origin returning adults resulting form tributary juvenile releases were monitored in the lake spawning aggregations. NOR sockeye salmon adults produced in the tributaries are expected to have a lower tendency to stray to beach spawning areas than F1 tributary program-origin adults. The intent of the HGMP is to limit hatchery-origin sockeye salmon straying to 1% or less of the lake spawning population or to levels below natural levels identified through analyses of DNA markers. Mass marking of hatchery-origin sockeye, and mark observation/recovery programs (fin clips and otolith marks) proposed through the HGMP in lake spawning areas are used to monitor straying of hatchery fish, and effects on spatial structure. Monitoring of NOR tributary-origin sockeye salmon adults to beach spawning areas may be feasible through recovery of otoliths and analysis of stable isotope ratios of salmon otoliths from different lake and tributary spawning areas. Estimated annual hatchery-origin sockeye salmon adult stray rates to beach spawning areas will be derived by the Makah Tribe for consideration by the co-managers and NMFS in assessing genetic risks to listed sockeye, allowable hatchery fish stray rate limits, and, if necessary, hatchery program modification or termination needs in response to excessive stray levels.

In addition to preserving and not disrupting the spatial structure of lake spawning populations, an intent of the HGMP is to expand spatial distribution of natural sockeye salmon production within the ESU by establishing self-sustaining sockeye salmon populations (originally derived from the listed lake spawning populations) in Ozette Lake tributaries. This is accomplished through annual hatchery sockeye salmon fry releases, and allowing the majority of sockeye salmon adults returning each year to the tributaries to spawn naturally. Whether the creation of tributary sockeye returns represents reestablishment of historical spatial use patterns for Ozette Lake sockeye salmon is uncertain. Opinions regarding historical sockeye salmon use of the tributaries vary (e.g.,

Gustafson et al. 1997; Makah 2000; Dlugokenski et al. 1981;WDF and WWTIT 1994; Jacobs et al. 1996). Regardless, use of available spawning habitat in the Basin for listed sockeye salmon production has the potential to be expanded through the HGMP. Preliminary data (Table 1) indicates that NORs have been produced as a result of the tributary hatchery program. Given that all indigenous, naturally spawned fish in the Ozette Lake sockeye salmon ESU are listed, the creation of self-sustaining sockeye salmon populations in the tributaries may expand the spatial structure of spawning, listed Ozette Lake sockeye salmon aggregations.

Cumulative loss of historic habitat has likely adversely affected the population structure of Ozette Lake sockeye salmon. As noted previously, Dlugokenski et al. (1981) suspected that logging-induced sedimentation led to decreased hatching success of sockeye salmon in the tributary creeks and creek outwash fans in Ozette Lake. Sedimentation from timber harvest and road building may also have contributed to the extirpation of any tributary spawning sockeye salmon aggregations that may have existed historically. Recent sediment sampling data collected from known beach spawning areas in Ozette Lake suggests that the current core, listed lake spawning aggregations may be adversely affected, and that the extent of usable beach spawning areas may be limited, by excessive sedimentation (unpublished analysis of substrate from core samples taken from mapped spawning beaches in 1999 and 2000 by MFM). Known beach spawning areas in Ozette Lake are confined to two locations at the south end of the lake. The primary beach spawning area - a site with upwelling at Olsen's Beach - is only 300 square meters in area. Effective, timely habitat preservation and restoration actions are necessary to preserve existing spatial structure, and to address any spatial structure deficiencies within the ESU.

4.) Diversity

Under VSP diversity guidelines, anthropogenic activities should not be allowed to substantially alter the diversity traits of existing spawning aggregations, and natural processes of dispersal and causes of ecological variation should be maintained. In past reviews of the Ozette Lake tributary hatchery sockeye salmon program, the potential adverse genetic effects of broodstock mining of the listed beach spawning population for use in past tributary hatchery programs have been raised as a concern (Gustafson et al. 1997). An additional concern that was identified is the potential genetic risk to the listed lake spawning sockeye populations associated with straying of sockeye salmon produced through the tributary hatchery program.

A concern for the potential hybridization of tributary spawning sockeye salmon resulting from the Makah Tribe's hatchery program with the indigenous kokanee salmon population has also been indicated. Contributing to this latter concern is the finding that the kokanee salmon population currently spawning in Ozette Lake tributaries is the most genetically distinct *Oncorhynchus nerka* population in the Pacific Northwest (Gustafson et al. 1997). The perceived risk is that hybridization between tributary sockeye salmon adults and any co-occurring kokanee might lead to deleterious genetic effects, decreasing the genetic diversity of the populations and potentially their survival fitness (Gustafson et al. 1997; Gustafson 1999). As acknowledged in the HGMP, the likelihood for sockeye and kokanee hybridization is low, but vulnerability is considered high

because of potential consequences (Makah 2000). Production of sockeye salmon in the tributaries may disrupt the natural reproductive isolation mechanisms that have kept lake spawning sockeye and kokanee distinct. Hybridization between the races could result in poor performance from outbreeding depression for crucial life history traits (Makah 2000).

The HGMP has been modified from earlier versions to respond to the above genetic concerns. The proposed hatchery program will rely on sockeye salmon adults returning to Ozette Lake tributaries for use as broodstock; the lake spawning populations will not be mined for use as hatchery broodstock. The primary purpose of the proposed tributary hatchery program is to create self-sustaining sockeye salmon populations in Ozette Lake tributaries where past sockeye salmon spawning and production may have occurred, and where kokanee populations are very small. If successful, the tributary stocking program may extend the range of Ozette Lake sockeye salmon within critical habitat designated for the listed ESU. This range extension may increase the diversity of life history traits and sockeye behavior, and potentially the morphology and genetic characteristics of sockeye salmon included in the ESU. This may occur as naturally produced sockeye salmon in Umbrella Creek and Big River adapt to tributary conditions, perhaps resulting in phenotypic and genetic divergence from the original, donor lake spawning populations. These changes may provide resilience to the tributary-spawning component of the ESU, perhaps allowing the aggregation to endure man-caused or natural catastrophic factors affecting the survival of the core, listed beach spawning aggregations.

Establishment of sockeye salmon returns in Basin tributaries (Umbrella Creek and Big River) may create a demographic reserve for Ozette Lake sockeye salmon. Creation of self-sustaining returns to the tributaries where sockeye were thought to have existed historically reduces the risk of population loss that could result from a catastrophic event or poor beach spawning habitat and productivity conditions, leading to the extinction or near extinction of the listed lake-spawning population. Initial NOR return data for Umbrella Creek indicates that the tributary program may be creating a self-sustaining spawning aggregation in the creek. In 1999, the estimated NOR replacement value for tributary-origin sockeye was 2.7 returning adults per spawner (Makah 2000).

The program's 12 year, or three sockeye salmon generation per release site, duration is intended to address the concern that repeated enhancement of the same population segment will result in a decrease in effective population size of the target population (WDFW and PNPTT 2000; Kapuscinski and Miller 1993). It also limits the length of time natural-origin sockeye salmon are exposed to potentially deleterious selective effects of hatchery conditions to a few generations, minimizing the likelihood for divergence between hatchery and natural-origin fish within the supplemented stock.

Research actions proposed under the HGMP to identify factors limiting sockeye productivity in lake spawning areas will lead to the random removal of up to five adult sockeye from each of the two spawning beaches. The progeny of these fish are planted back on the appropriate beaches through experiments designed to assess egg and fry survival. The removal of ten adult fish

represents < 1% of the projected beach spawning population returning to the lake. Adult fish removal at this level, and the attendant egg/fry survival studies, are expected to have little effect on the genetic diversity of the two lake spawning groups. All other monitoring and evaluation and research actions proposed under the HGMP that will affect sockeye salmon involve capture and release (e.g., adult sockeye radio-tagging research and smolt trapping in the Ozette River). No adverse genetic effects are anticipated for these other programs.

The intent of the HGMP is to maintain tributary-origin sockeye stray rates to beach spawning areas at under 1%. Analyses of DNA markers is also intended for use in determining whether stray rates are above "natural" levels. The 1% stray rate objective is very stringent, given that the stock of concern regarding straying impacts is the original donor broodstock for the hatchery program. The HGMP stray rate objective is below the generic VSP stray level limit range designed to maintain genetic diversity of natural-origin salmon populations. Imprinting of hatchery-origin sockeye salmon to the tributaries through incubation and/or rearing in Umbrella Creek and the Big River as per NMFS (1999) conservation hatchery recommendations are expected to minimize the likelihood for straying of adult fish to lake spawning areas.

The risk of interbreeding between hatchery tributary and lake spawning sockeye salmon is low. Preliminary stray rate monitoring results indicate no hatchery-origin sockeye have been present on Olsen's Beach (1999 data from Makah 2000; 2000 data from MFM, unpublished data), and hatchery measures are applied to minimize the risk of straying (e.g., imprinting of fish to tributary return locations through on-site incubation, rearing and release). Low risks of straying and interbreeding, and the fact that the tributary stock used for the hatchery program is only one generation removed from the donor beach spawning aggregations, limit outbreeding depression risks to the listed beach spawning populations that are the focus of recovery. As noted previously, the Makah Tribe intends to identify locations of spawning areas in Ozette Lake and its tributaries and to count and sample for marks sockeye adults using the areas each year. These monitoring and evaluation actions are expected to improve scientific understanding of the annual degree of straying to listed fish spawning areas, and hence outbreeding depression risks posed by tributary hatchery program-origin sockeye salmon to the beach spawning population.

The co-managers propose to manage the two known lake spawning aggregations as distinct populations to maintain genetic diversity. The HGMP proposes identification of Ozette Lake areas used by beach spawning sockeye, and monitoring and evaluation of genetic characteristics of the lake spawning sockeye salmon populations. Genetic stock identification samples (DNA-based) are collected from lake spawning sockeye aggregations to describe the genetic variation of sockeye salmon spawning in Ozette Lake. A genetic baseline is being developed for use in monitoring changes in allelic characteristics, and to assess whether the tributary hatchery program negatively affects the genetic diversity of the natural lake-spawning populations over time. The Makah Tribe, in conjunction with the Northwest Indian Fisheries Commission (NWIFC), and WDFW received initial funding, through the Hatchery Scientific Review Group, to conduct research to monitor the genetic composition of all potential populations or sub-populations of Ozette Lake sockeye salmon and kokanee salmon. The co-managers compiled and consolidated a detailed inventory of tissue

samples of *O. nerka* spawning aggregations from this and previous studies in the Ozette Lake Basin for use in this study and possible future investigations. The inventory now contains six years of samples from Olsen's Beach (573 samples), five years of Allen's Bay samples (244 samples), two years of samples from Umbrella Creek adults (159 samples), one year of samples from Umbrella Creek fry (105 natural-origin and 46 hatchery-origin samples), and one year of kokanee samples (100 samples from Siwash Creek and 142 samples from Crooked Creek).

Baseline genetic profiles developed from the above samples by WDFW using microsatellite DNA loci revealed genetic differences between sockeye salmon spawning at different beaches and among spawners returning in different years to the same beach. Although suggesting that the two spawning beaches may be different sub-populations, this finding was not conclusive because fish spawning in different years were also different. There was insufficient funding for further analyses to resolve and compare temporal and geographical variation adequately from other return years. Continued collection and analysis of archived and new Ozette Lake *O. nerka* samples from other years is necessary to provide a more complete comparison of geographical and temporal differences and to determine if genetic differences observed among beach-spawning populations are a consistent pattern. This information will help ensure that appropriate measures are applied to maintain the genetic diversity of existing Ozette Lake sockeye salmon spawning aggregations. Mass marking of hatchery fish, spawning ground surveys, and mark recovery programs are proposed in the HGMP to monitor straying and to allow for a management response to excessive hatchery-origin fish straying levels to beach areas.

WDFW's baseline genetic profiles also indicated large genetic differences between sockeye and kokanee populations in the Ozette Lake Basin. These findings indicate that it will be possible to use genetic markers to monitor potential hybridization among kokanee and sockeye salmon. To help address concerns for sockeye salmon and kokanee hybridization and genetic introgression effects, the HGMP limits tributary hatchery production of sockeye salmon to Umbrella Creek and Big River, where few kokanee are observed, and where there are no documented, self-sustaining kokanee populations (Makah 2000). The shift in focus of the tributary hatchery program to the release of sockeye juveniles only into Ozette Lake streams with very small kokanee abundances follows NWIFC fish geneticist recommendations for limiting hybridization risks (Currens 1999). Incubation, rearing and release of juvenile sockeye in Umbrella Creek and Big River are likely to imprint the fish to these streams, reducing the risk of hatchery adult sockeye salmon straying to kokanee production areas. As previously noted, data collected thus far indicate that straying of tributary-origin sockeye to beach spawning areas has been low (no marked hatchery-origin sockeye were observed on beach spawning areas in 1999). Mass marking of hatchery-origin sockeye via otolith marking, and adipose fin clip marking of fed fry releases at the hatchery sites, are proposed in the HGMP to allow for continued monitoring of hatchery fish straying. Spawner surveys and mark recovery programs conducted through the HGMP will help indicate whether hatchery-origin sockeye salmon released into Umbrella Creek and Big River are straying to kokanee production streams in future years.

As noted above, the Makah Tribe received funding for one year to conduct initial research to monitor the genetic composition of all potential populations or sub-populations of Ozette Lake sockeye salmon and kokanee salmon (Makah 2000). The genetic profile created through this study and through additional funded genetic analyses may help identify genetic markers for these races. Preliminary results of the initial study revealing large genetic differences between sockeye and kokanee populations in the Lake Ozette Basin, indicate that it will be possible to use genetic markers to monitor potential hybridization among kokanee and sockeye salmon

Past hatchery sockeye releases by the Makah Tribe were made into Crooked Creek, an Ozette Lake tributary harboring a kokanee salmon population. Adult returns resulting from this now terminated hatchery program are expected in the 2000, 2001, and 2002. Under the HGMP, any adult sockeye salmon returning to Crooked Creek will be removed if possible and used to supplement broodstock collections in Umbrella Creek. During return year 2000/2001 spawning ground surveys, no adult sockeye salmon were observed to have returned to Crooked Creek that may have resulted from the first of three eyed egg plants (brood years 1996, 1997, and 1998) (MFM unpublished data). No juvenile sockeye salmon produced by adult fish trapped in Crooked Creek will be planted back into Crooked Creek. The intent is to eradicate adult sockeye returns resulting from past hatchery fish releases as a measure to prevent tributary-returning sockeye hybridization with kokanee. Adult collections from Crooked Creek will augment Umbrella Creek collections, allowing for a reduction in the number of fish removed from Umbrella Creek, resulting in increased natural spawning in Umbrella Creek.

The artificially propagated sockeye population is also a focus of genetic diversity preservation actions. Sections 6, 7, 8, and 9 of the HGMP describe broodstock selection, collection, mating, juvenile fish rearing, and fish release measures applied to minimize the risk of within and among population diversity loss to the donor tributary-returning population destined for natural spawning, and to the artificially propagated sockeye salmon population produced for release into Umbrella Creek and Big River. A weir is used to collect sockeye broodstock randomly and representative of the overall Umbrella Creek return commencing in October and continuing through the entire spawner entry period (December). Seining may also be employed during this period to procure ripe fish in Umbrella Creek, if necessary to augment weir captures. After the expected, low 2001, 2002 and 2003 adult return years, a maximum of 40 pairs of the total return to Umbrella Creek will be collected for supplementation of Umbrella Creek to ensure that adequate natural escapement and enhancement of natural spawning in Umbrella Creek. Total brood stock take for the Big River program will be limited to no more than an additional 60 pairs or a combined 15% removal, whichever is lower, from Umbrella Creek per year. This allows for growth of natural spawning aggregations in Umbrella Creek as per the broodstock collection guidelines previously discussed. A factorial mating design (4 males x 4 females spawning matrix) is proposed to lower the risk of effective population size reduction, increase the likelihood for unique genetic combinations, and to provide for back-up fertilization (as per recommendations in Hard et al.1992). The effective spawner population size (N_e) resulting from this mating scheme is approximately 168 (Makah 2000). A minimum N_e of 80 to 100 spawners is recommended to maintain within population genetic diversity of a propagated salmon population for limited duration hatchery programs (Hard

et al. 1992). Sockeye juveniles produced through the HGMP will be reared for a minimal duration (approximately 60 days - most of the fish will be released as fed or unfed fry), minimizing the likelihood for domestication selection effects. Standard fish cultural and fish health maintenance practices will be applied to minimize the risk of catastrophic loss of all, or discrete portions, of the propagated population.

In summary, little, if any, alteration of the diversity traits of the listed lake spawning populations is expected as a result of the proposed tributary hatchery, monitoring and evaluation, and research programs. Protocols applied through the hatchery component of the program are adequate to maintain the genetic diversity and fitness of the propagated tributary sockeye salmon aggregations that are established. The approaches proposed in the HGMP are consistent with NMFS conservation hatchery guidelines, which call for maintenance of the genetic diversity of each population as much as possible, and the use of locally adapted broodstock to maintain long-term fitness traits (NMFS 1999).

5(i)(C) Taking into account health, abundances, and trends in the donor population, broodstock collection programs reflect appropriate priorities.

From this section of the 4(d) Rule, a prioritized purpose of a broodstock collection program using listed fish is to reestablish an indigenous salmonid population for conservation purposes, including restoration of similar at-risk populations within the same ESU, and reintroduction of at-risk populations to under-seeded habitat. One objective of the HGMP is to colonize vacant tributary habitat in the Ozette Lake system using tributary-origin sockeye salmon originally derived from the listed beach-spawning population. This colonization effort is experimental. However, the program is operated for conservation purposes, creating natural-origin, listed sockeye salmon aggregations in the tributaries using tributary spawners as hatchery broodstock, and avoiding collection of listed lake spawning sockeye salmon as broodstock.

The broodstock collection program proposed in the HGMP reflects priorities appropriate for the health, abundance, and trends in the listed, original lake-spawning donor population. As noted previously, the HGMP has modified previous hatchery practices, terminating removal of the listed lake spawning sockeye adults for use as hatchery broodstock. Limitations on the annual removal of adult sockeye salmon to ten fish, for research purposes only, maintains the health, abundance and trends of the listed lake spawning population. Adult sockeye salmon derived from the lake spawning stock are now returning in sufficient numbers to Umbrella Creek to sustain the proposed tributary colonization program. The donor stock for the supplementation program is now the listed NOR and unlisted F1-origin adult sockeye salmon return to Umbrella Creek (and, for the near term, Crooked Creek). Collection of listed NOR sockeye returning to Umbrella Creek as broodstock for the tributary program is consistent with the NMFS ESA listing document findings (FR 64 14528, March 25, 1999). In the listing notice for Ozette Lake sockeye salmon, NMFS stated that it is desirable to incorporate naturally spawned fish into the hatchery population to

ensure that genetic and life history characteristics do not diverge significantly from those of the natural populations.

Consistent with the objective of establishing a self-sustaining natural-origin return in Umbrella Creek, the HGMP proposes to limit annual broodstock collections after 2003 to a maximum of 40 pairs from the total return for use in the Umbrella Creek supplementation program. Total brood stock take for the Big River program will be limited to no more than an additional 60 pairs from Umbrella Creek per year. The total collection from Umbrella Creek will not exceed 15% of the return each year. For reasons discussed above (starting on page 13), this approach is expected to be sufficient to maintain the health, abundance and trends of the natural-origin tributary aggregation serving, with F1 hatchery-origin fish, as donor stock. NOR sockeye salmon produced in the tributaries have not been identified as a part of the recovery population for the listed ESU. Decisions regarding the standing of tributary-origin sockeye salmon are pending TRT Ozette Lake sockeye salmon ESU recovery deliberations.

5(i)(D) The HGMP includes protocols to address fish health, broodstock collection, broodstock spawning, rearing and release of juveniles, deposition of hatchery adults, and catastrophic risk management.

1.) Fish Health

Protocols addressing fish health, including fish health maintenance and hatchery sanitation procedures applied during broodstock collection, mating, fish incubation, and rearing are detailed in HGMP sections 4.3, 7.3, 8.5, and 8.12. Fish health monitoring and evaluation measures are presented in section 10.4 of the HGMP.

The Makah Tribe and the co-operating agencies will operate the program in compliance with "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" protocols (NWIFC and WDFW 1998), and will apply standard fish health maintenance and hatchery sanitation practices (e.g., as per PNFHPC 1989 guidelines). A major objective of the fish health program is to monitor the incidence of infectious hematopoietic necrosis (IHN) virus in adult sockeye collected as broodstock, and to limit the incidence of this regulated fish pathogen in the artificially propagated egg and fry population each year. Included are measures to limit the risk of fish disease amplification by screening broodstock for regulated and reportable fish pathogens, including IHN virus. Sanitation and disease control procedures applied during spawning and incubation include water-hardening of eggs in an iodophore solution, treatment of incubating eggs to control fungus, and removal of dead eggs when incubating eggs reach the eye-up stage. Adult salmon will be vaccinated upon capture to develop their specific immunity to the IHN virus during holding in hatchery tanks prior to spawning. Isoincubation facilities and procedures are used to limit the risk of IHN disease transmission (if present) between egg groups. Fish are maintained at low densities during incubation and rearing to reduce stress, and they are monitored monthly by fish health professionals for the incidence of disease. Any disease control treatments applied are in

accordance with USFWS or NWIFC fish pathologist recommendations and approved protocols. Sockeye salmon fry or fingerlings are examined prior to release into the natural environment to certify the fish health status of the artificially propagated population.

Fish health monitoring and reporting will include identification of the pathogen status of sockeye salmon broodstock spawned. The parental pathogen status and health of eggs incubated at Makah National Fish Hatchery (NFH) are monitored by a disease sub-panel comprised of USFWS, Makah, WDFW, and NWIFC fish health specialists to coordinate fish health procedures. Survival and health of fry produced at Umbrella Creek Hatchery are monitored by a NWIFC pathologist and by Makah technical staff. As provided in the HGMP (section 8.12), the annual presence or absence of regulated and reportable fish pathogens in sockeye salmon reared at Umbrella Creek Hatchery will be documented.

No regulated infectious fish pathogens have been detected in Ozette Lake sockeye salmon used as broodstock for the Umbrella Creek Hatchery program over the past six years (1994-99). Sockeye salmon egg and fry propagated through the hatchery program have had high survival rates, averaging 83.9% for the green to eyed egg stage, 98.3% for the eyed egg to fry swim-up stage, and 86.0% from the swim up to release (1986-98 brood year averages). These rates are indicative of a well operated program that applies appropriate fish health management measures to prevent fish disease epizootics. The fish health protocols proposed through the HGMP are appropriate for the protection of the listed sockeye salmon population, and of the sockeye salmon under artificial propagation. The proposed program is expected to adequately safeguard listed sockeye salmon from fish disease impacts.

2.) Broodstock Collection

Sections of the HGMP describe in detail broodstock selection criteria, and broodstock collection limits and methods, and broodstock holding practices and methods. Adult sockeye salmon returning to Umbrella Creek and Crooked Creek are the brood source for the tributary hatchery program. In past years, sockeye salmon were collected from Ozette Lake spawning beaches for artificial propagation. Progeny of these fish were planted in Ozette Lake and in several tributaries, and were the source broodstock for present tributary returns. Under the proposed HGMP, the tributary hatchery program will rely only on adult sockeye salmon returns to Umbrella Creek (augmented by collections in Crooked Creek) to sustain the program. The lake spawning population will not be used as broodstock for the portion of the HGMP pertaining to tributary supplementation and reintroduction. A small number of adult sockeye salmon are collected from Ozette Lake each year for research purposes.

Sockeye salmon used as broodstock for the tributary hatchery program are trapped in Umbrella Creek as returning adults originating from hatchery releases (F1s) or from naturally spawning hatchery-origin returns (NORs). Up to 200 adult sockeye salmon will be trapped in lower Umbrella Creek using a weir. Weir collections may be augmented by seining of gravid fish upstream of the weir if necessary. Broodstock collection may also occur in Crooked Creek to

supplement Umbrella Creek collections, allowing more sockeye to spawn naturally in Umbrella Creek. Crooked Creek removals also are designed to minimize the risk of interbreeding between kokanee and hatchery-origin sockeye released into Crooked Creek through a now-terminated program.

Broodstock are collected in the tributaries from October through December, encompassing the spawner entry period. Sockeye salmon broodstock are collected randomly as the fish arrive at the trap location, proportional to the timing, weekly abundance, and duration of the total return to the creek. Collection protocols allow for the random selection of broodstock that is representative of the total tributary return, without bias towards origin (F1 vs NOR), return timing, fish size, or fish age. Fish are transferred for holding through spawning at Umbrella Creek Hatchery in circular tanks. Alternatively, sockeye adults may be spawned on-site at the creeks of capture, with gametes transported for incubation at one of the isoincubation facilities.

Up to ten adult sockeye may be collected from the lake spawning aggregations each year to produce eggs for a research program designed to help identify egg and fry survival conditions on Ozette Lake spawning beaches. Five adult sockeye may be removed for holding and spawning at Umbrella Creek Hatchery from Olsen's Beach and also from Allen's Bay. Sockeye are collected live from the beaches using a gill-net tended continuously by tribal staff. These two groups are held and spawned separately from each other and from tributary broodstock. In 2001, 50 to 100 fin samples will be collected for genetic analysis from carcasses or from live adult sockeye salmon, targeting spawned-out fish from each beach. Live fish will be carefully released after tissue sampling (fin clip) for genetic analysis purposes.

Monitoring and evaluation measures are included in the HGMP to collect data that will identify whether broodstock collection practices are leading to ecological or genetic changes in the propagated population, and in the listed lake population. Mass marking of hatchery production via otolith banding, and fin-clip marking of a sufficient number of fry and fingerling sockeye released from the Umbrella Creek Hatchery site, will allow for differentiation of hatchery and wild fish in tributary and lake spawning areas during (for fin-marked fish) and post-spawning. Genetic studies proposed in the HGMP will improve information regarding the characteristics of the lake and tributary sockeye populations and kokanee. Protocols are in place to adjust the program in the event that adverse changes in the character or productivity of the donor sockeye salmon population result from implementation of the HGMP broodstock collection protocols.

3.) Broodstock Spawning

Broodstock spawning protocols are described in the HGMP (section 7). Mating procedures are conducted in accordance with NMFS guidelines for artificial propagation under the ESA (Hard et al. 1992). A partial factorial mating procedure using a four female by four male spawning matrix is applied. Adult sockeye salmon spawned in each factorial mating are randomly selected from the pool of eligible ripe adults on each spawning date. This mating design was chosen to minimize the effects of selection. The design is proposed to lower the risk of effective population size

reduction, increase the probability of unique genetic combinations in the brood, and provide for back-up fertilization by males.

Spawning is accomplished at Umbrella Creek Hatchery, or potentially on Umbrella or Crooked creeks adjacent to fish capture locations. Gametes are collected and stored in oxygenated plastic bags for transport to isoincubation locations at Makah NFH, and at the Makah Tribe's Educket Hatchery if needed. Approximately 305,000 unfertilized eggs will be collected from tributary-origin sockeye each year for incubation and the production of eyed eggs or fry for out-planting. Up to 6,000 sockeye eggs may also be taken from up to 10 lake spawning sockeye adults (up to five spawning pairs) for planting in natural gravel in egg baskets on beaches to assess egg and fry survival. Some eggs from these beach spawners may also be used for survival assessments in Jordan-type incubators to test the use of the egg planting methods as a tool for future sockeye re-establishment projects directed at vacant beach spawning habitat.

4.) Rearing and Release of Juveniles

Sockeye salmon incubation, rearing and release protocols are detailed in sections 8 and 9 of the HGMP. Protocols for incubation call for the use of isoincubation units at Makah NFH or Educket Creek Hatchery. By incubating all sockeye eggs at these locations, the eggs are provided enhanced protection from catastrophic loss and fish disease. Back-up water supply systems, alarm systems, and on-site staffing at the hatcheries decreases the likelihood for egg mortality from power loss, flow loss, or flooding. Isolated incubation practices are applied (low egg incubation densities, sequestered water supplies and discharges) to reduce the risk of fish pathogen (IHN virus) amplification in the propagated sockeye salmon population. Eggs at both sites are incubated on pathogen-free water in bucket-style or Heath-type trays through the eyed stage. All eggs are otolith marked using standard thermal marking procedures during incubation. Differentiating otolith marks are applied to various release groups (different release locations, rearing and release strategies, or life stages at release) to allow for assessment of origin and survival rates during smolt emigration and upon adult return. The recent year average "green" (unfertilized) egg to eyed egg survival rate for the sockeye hatchery program was 83.9%.

When reaching the eyed life stage, eggs destined for the production of unfed fry and fingerling sockeye salmon releases are transported to Umbrella Creek Hatchery for incubation until hatching. Eggs and fry are propagated at low densities using gravity-fed water from Umbrella Creek. Eggs are incubated to hatch in Nopad-type incubators. The recent 12 year average survival rate at the hatchery from the eyed egg to swim-up stage was 98.3%. Upon swim-up (mid-April to late May), the fry are ponded into rearing troughs and reared on an artificial diet, potentially supplemented with live feed as a natural rearing strategy. The fry are retained in the troughs until successfully started on feed. The fry are then transferred into ten-foot diameter circular fiberglass tanks for approximately 60 days of rearing to a final target average individual fish size of one gram. A proportion of the mass otolith-marked fry produced at Umbrella Creek Hatchery are also marked with an adipose fin clip to allow for visual identification of the fish during smolt emigration and upon adult return. The proportion of sockeye salmon receiving an adipose fin clip each year will

be sufficient to allow for statistically significant evaluations of adult fish straying to beach spawning locations. Up to 80,000 fed fry are released into Umbrella Creek from late-March to late-June each year at dusk.

Sockeye salmon eggs from Makah NFH or Educket Hatchery are also transferred to remote stream-side incubators (RSIs) in the Big River watershed. Up to 140,000 otolith-marked eyed eggs may be transferred for incubation and fry release each year, assuming average survival rates for the 120 adult tributary-origin sockeye spawned for the Big River program. Resultant fry volitionally emigrate from the RSIs into plastic raceways from mid-March to late April each year. Half of the annual Big River RSI sockeye fry production is released from the raceways into the Big River as otolith-marked, unfed fry within a few days after swim-up at an average size of approximately 0.15 gram (3,000 fish per pound (fpp)). Unfed fry are not additionally marked with an adipose fin clip, because their small size precludes application of such a mark. Unfed fry are produced through the program for comparison of unfed and fed fry survival rates to adult return. The remaining half of the annual hatchery production is reared for 30 to 45 days on an artificial diet for release in the early summer as fed fry. A proportion of fed fry produced at the Big River site receive an adipose fin clip mark to augment the otolith mark. The proportion marked with a fin clip will be sufficient to allow for evaluation of adult contribution and stray rates to beach spawning areas. The production of fed fry at the Big River site follows protocols applied at Umbrella Creek Hatchery. A representative sample of adult sockeye salmon returning to the Big River will be sampled for otoliths and fin clips to compare unfed versus fed fry survival rates and to identify NOR contribution.

Under the HGMP, up to 6,000 otolith-marked eyed eggs originating from 10 lake-spawning sockeye salmon broodstock produced for research purposes will be transferred from the isoincubation hatcheries to their beaches of origin (either Allen's Bay or Olsen's Beach). The eyed eggs will be manually planted on the beaches in natural gravel inside egg baskets to assess limiting factors during egg incubation in beach gravel. Eyed eggs will be removed prior to hatching to assess survival.

5.) Disposition of Hatchery Adults

Plans for the disposition of adult sockeye salmon are indicated in HGMP section 6.2.6. The number of sockeye salmon broodstock collected each year is limited to 200 adults from Umbrella Creek (augmented as necessary by Crooked Creek collections) and up to 10 adults from the lake spawning areas. The potential for possession of surplus adults and eggs or juvenile fish through the program is therefore low. Remaining adult hatchery-origin sockeye salmon derived from native lake spawning sockeye stock are allowed to spawn naturally in the Ozette Lake tributaries. Carcasses resulting from spawners collected from Umbrella Creek and the lake are returned to the stream or lake, respectively, after spawning. Return of carcasses to the tributary and lake provides ecosystem-wide benefits through nutrient enrichment. The caudal fin is removed from carcasses returned to the natural environment to distinguish fish used for broodstock from carcasses of naturally spawned fish during spawner abundance surveys.

No adult sockeye are retained through other monitoring and evaluation and research activities planned in the HGMP. Adult sockeye trapped in the Ozette River for sockeye salmon migration and spawning behavior evaluation purposes are released after biological sampling and tagging are completed. The majority of these fish will spawn naturally in the Ozette Lake Basin.

6.) Catastrophic Risk Management

Catastrophic risk management strategies that are applied to minimize the risk of loss of sockeye salmon under propagation, or collected for monitoring and evaluation or research purposes, are included in the HGMP.

Measures applied to limit risks to adult sockeye collected as broodstock for the tributary hatchery program are detailed in HGMP section 6.2.3. The temporary weir/trap in Umbrella Creek that is used to collect broodstock is monitored by Makah tribal staff continuously during operation to ensure safety of migrating sockeye salmon. Weir pickets are spaced to allow juvenile salmonid passage, and weir panels are removable to allow adult fish to pass upstream or downstream. The trap is actively operated to remove captured sockeye salmon at least once daily. Adult sockeye or other salmon species captured in the trap that are not retained as broodstock will be released from the trap upstream. Any seining in Umbrella Creek and Crooked Creek necessary to collect sockeye salmon broodstock is conducted to limit incidental effects on non-target fish. Broodstock are retained consistent with previously described broodstock collection guidelines, which limit the proportion of spawners collected. Trapping mortality is expected to be low for sockeye adults retained for spawning. Sockeye broodstock are spawned on-site (seining operations) or transported from the Umbrella Creek trapping location in fish tanks supplied with oxygen for holding under controlled conditions at Umbrella Creek Hatchery. Under these fish capture and holding methods, incidental mortality is expected to be less than 6%. Actual capture and holding mortality in 1998 and 1999 was less than 3.5% of the total adult sockeye collected as broodstock (Makah 2000).

An alarm system and back up pumps are provided at Makah NFH, where initial egg incubation will be conducted beginning in 2001. Makah NFH is staffed full-time to allow rapid response to other factors, such as flooding, that could harm incubating eggs. Umbrella Creek Hatchery is supplied with water that is gravity-fed from an adjacent pond. Incubating and rearing eggs and fry will therefore not be affected by power failures. Nevertheless, this facility was recently equipped with satellite phone alarm and backup oxygen systems linked to a float switch on the inflow to respond to flow loss, and to alert hatchery personnel regarding any potential water failure. Umbrella Creek Hatchery is not generally staffed full time, but is checked at least once daily during operation and more frequently during freshet or cold weather events. Disease control measures applied to minimize the risk of catastrophic loss have been previously described, and are adequate to protect sockeye under propagation and natural fish. Average egg to fry survival rates have been high, indicating the operation of a hatchery program that applies appropriate methods for minimizing fish losses.

Appropriate catastrophic risk management protocols are also applied in proposed monitoring and evaluation and research actions. The number of sockeye adults collected for the predation and migration assessment study in the Ozette River is limited to 200 adults out of the total run (<10% of expected average run sizes). The majority of sockeye adults encountering the collection weir used for the study in the lower Ozette River will be promptly removed from the trap livebox and allowed to pass upstream. All sockeye retained for tagging are handled in a manner that minimizes harm, including application of anesthetics to ease fish handling, placement of radio/sonic tags using standard methods, and allowance for fish recovery prior to upstream release. Fyke nets and the smolt out-migration traps operated to gauge sockeye population productivity and hatchery sockeye juvenile post-release survival are monitored regularly during trapping. Fry captured in fyke nets are removed for sampling and released at least daily. Sockeye salmon juveniles captured in the upper Ozette River screw trap are removed from the trap live box at least every twelve hours to prevent trap-induced mortality. In particular, the live box is checked in the morning and just after dusk each day to remove, enumerate, biological sample by species, and release all fish. Salmonids and other fish emigrating from Ozette Lake appear to enter the trap at an accelerated rate at dusk. Removal of accumulated fish from the trap live box after dusk reduces the likelihood for juvenile sockeye salmon predation by commingled predator fish species (e.g., northern pikeminnow) in the live box. Sockeye salmon captured incidentally in Ozette Lake through beach seining conducted for piscine predation research purposes will be maintained in water at all times, and released unharmed after enumeration and (if needed) biological sampling. Standard fish handling and sampling practices are applied to limit the risk of catastrophic loss during all trapping and fish capture operations.

5(i)(E) The HGMP evaluates, minimizes, and accounts for the propagation programs' genetic and ecological effects on natural populations, including disease transfer, competition, predation, and genetic introgression caused by straying of hatchery fish.

The HGMP applies a risk management approach designed to allow for the adaptive management of hatchery actions based on the results of tributary sockeye salmon population enhancement actions, and the results of monitoring and evaluation and research. The effects of the program are evaluated using results from intensive monitoring programs aimed at natural and hatchery-origin sockeye salmon adult returns and juvenile sockeye production in the lake and tributaries. Potential negative effects on natural-origin, listed sockeye salmon are limited by applying risk averse actions that lower the probability of an unwanted event occurring, and by applying measures that will help minimize the loss of fish should some event occur. Specific measures implemented to minimize adverse genetic, ecological, and demographic effects on listed fish are included within each section describing the hatchery fish production, monitoring and evaluation, and research components of the proposed program. To account for potential effects, the HGMP lists estimated sockeye salmon take levels for each proposed action, and indicates the likelihood for potential genetic and ecological effects to listed fish in relevant sections. Monitoring and evaluation measures are designed to annually identify actual program effects in future years.

1.) Genetic Effects

Potential genetic effects to listed sockeye that may result from the implementation of proposed programs, in particular, operation of the tributary hatchery sockeye salmon program, are evaluated in the HGMP. The potential for tributary-origin sockeye salmon adult straying to lake spawning areas is assessed, based on marked hatchery fish observations in lake spawning areas and measures applied to limit the likelihood for straying. Otolith mass marking of all artificially propagated sockeye groups (hatchery and research programs) and recovery of marked otoliths from adult sockeye during spawning ground surveys are proposed to monitor and evaluate F1 tributary hatchery-origin, and if feasible listed NOR tributary-origin, sockeye stray rates to lake spawning areas. Monitoring for the presence of adipose fin-clipped fish will also be used to evaluate hatchery fish straying. Monitoring and evaluation and research programs are being implemented through the HGMP to assess the potential for hybridization and gene flow among all *O. nerka* spawning aggregations within the Basin (HGMP Attachment 2).

Tributary-returning adult sockeye originally derived from the listed beach-spawning stock are used as broodstock for the Umbrella Creek and Big River hatchery programs. This eliminates the potential for broodstock mining of natural-origin lake spawning aggregations and any effects on reducing the effective population size of the core, listed sockeye population. Although sockeye propagated in the tributaries were derived from listed lake-spawning stock, there is a concern for potential outbreeding depression effects to the donor lake spawning population as a result of genetic introgression by hatchery sockeye. The HGMP evaluates the risk of hatchery sockeye straying using recent mark recovery data. The only sockeye salmon return years during which externally marked hatchery-origin adults were monitored in lake spawning aggregations after tributary release were 1999 and 2000. In those years, no straying of tributary-returning, hatchery-origin sockeye salmon adults was observed in more than 300 beach spawners examined for fin clips. Hatchery sockeye produced through the HGMP are imprinted to their tributary release locations through on-site incubation and/or rearing. The propensity of hatchery-origin fish to stray to lake spawning areas and interbreed with beach spawning sockeye is limited by these practices. The HGMP limits allowable straying of hatchery fish to lake spawning areas to 1% of the lake-spawning population or to levels below natural sockeye salmon stray rates identified through analysis of DNA markers. As noted previously, this stray rate limit is below the limit proposed in the NMFS VSP document as acceptable to minimize genetic introgression risks to natural-origin salmon populations posed by hatchery populations originating from within the natural fish ESU (NMFS 2000a).

Section 10 of the HGMP, and appended research plans, describe a comprehensive monitoring and evaluation program to track the program's genetic effects on the natural sockeye salmon and kokanee populations. Although fidelity of tributary hatchery-origin adult sockeye to the Umbrella Creek release site preliminarily appears to be high, a hatchery fish mass marking and spawning ground mark recovery program is planned to evaluate hatchery fish straying in future years. All hatchery fish will receive an otolith mark during incubation. In addition, a proportion of the sockeye salmon released as fed fry at the hatchery sites each year are externally marked with an

adipose fin clip. Mark recovery observations from lake and tributary spawning areas are used to indicate genetic introgression risks posed by the hatchery program to the lake spawning population. If straying of hatchery-origin sockeye to lake spawning areas is determined to be greater than 1% (the HGMP stray rate limit), or above natural levels identified through analysis of DNA markers, the program will be re-evaluated and adjusted to minimize straying.

Enhanced opportunity for hybridization between tributary-spawning sockeye salmon established through the hatchery program with kokanee is also a concern. The HGMP acknowledges that culture and release of sockeye salmon in the tributaries could disrupt natural reproductive isolation mechanisms that have kept lake spawning sockeye salmon and kokanee distinct. Under the HGMP, hatchery sockeye salmon production is limited to Umbrella Creek and Big River, which reportedly have very low numbers of kokanee. In addition, F1 sockeye adult returns to Crooked Creek are proposed to be removed in 2000 through 2002 under the HGMP to prevent interbreeding between kokanee and adult sockeye returning from a now-discontinued hatchery planting program. Hatchery sockeye salmon releases into Crooked Creek were curtailed to limit hybridization risks. These measures are expected to adequately limit the potential for enhanced hybridization between sockeye and kokanee.

As mentioned above, to minimize genetic risks, the proposed tributary hatchery programs will be evaluated after 12 years, or three sockeye salmon generations, per release site. The overall goals and objectives for the program will also be reevaluated throughout the duration of the proposed programs to incorporate new findings. The ability to meet minimum escapement and spawner distribution goals for release streams for each brood year will be considered in defining success or failure of the tributary program and its subsequent continuance or termination.

Additional measures proposed to minimize the risk of adverse genetic effects to the naturally spawning tributary sockeye salmon aggregations created through the HGMP are:

- use of the returning tributary population (derived from the lake spawning stock) as broodstock;
- limitation on removals of returning tributary adults after 2003 to a maximum of 40 pairs of the total return to Umbrella Creek for supplementation of Umbrella Creek to ensure adequate natural escapement and enhancement of natural spawning in Umbrella Creek;
- limitation on total broodstock removals from Umbrella Creek for the Big River program to no more than an additional 60 pairs or a combined 15% removal, whichever is lower;
- collection of a random, representative sample of returning spawners as broodstock;
- application of factorial mating scheme for egg fertilization to retain a high effective population size;
- minimal rearing duration and interference into the natural sockeye salmon life cycle to limit domestication effects;
- imprinting of fish to the tributary release locations;

- application of fish disease management procedures to prevent loss of population components; and
- application of catastrophic risk management procedures to minimize the risk of population loss.

All of the above measures are designed to assist in decreasing potential risks of within and among population diversity loss to the tributary spawning aggregations established through the HGMP, and genetic divergence of the propagated populations from the original donor listed sockeye population.

To monitor hybridization and gene flow among all sockeye salmon and kokanee aggregations in the Ozette Lake basin, a genetic characterization study was initiated in 2000. Through the study, tissue samples were collected from carcasses and when necessary, from live spawned out fish, for DNA-based genetic stock identification analysis. New genetic samples will continue to be combined with archived samples collected from past years. Genetic profiles of sockeye and kokanee spawning aggregations will be developed from analysis of these samples. The genetic baseline created will help determine whether genetically distinct lake spawning aggregations exist in Ozette Lake, and the degree to which tributary hatchery program sockeye have diverged (if at all) from the original donor lake spawning aggregations. The baseline may also be used to monitor genetic changes in the extant *O. nerka* populations over time, and the effects of hatchery actions on the genetic characteristics of the natural and artificially propagated sockeye salmon aggregations.

2.) Ecological Effects

The ecological effects resulting from implementation of the HGMP are also evaluated, minimized (through application of operational practices), and accounted for in the HGMP. Ecological effects of greatest concern include disease transfer and food resource competition effects on natural-origin sockeye salmon.

Measures implemented to minimize disease transfer effects on listed natural-origin sockeye, and to the propagated sockeye populations, are described. IHN virus is a ubiquitous fish pathogen affecting many west coast sockeye salmon populations. The HGMP acknowledges the importance of screening adult and juvenile sockeye salmon used in the hatchery programs for this pathogen, and in reducing the risk of fish disease amplification. Disease monitoring and control protocols in the HGMP comply with the "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" (NWIFC and WDFW 1998). Fish health monitoring, fish disease control, and hatchery sanitation practices are applied under the direction of fish pathologists to limit disease risks. Incubating eggs are segregated for each matrix-spawning group to reduce the risk of horizontal transmission of IHN virus between infected and non-infected egg take groups. Egg groups are isolated during incubation until results of IHN virus testing of parent brood fish are in hand. A disease sub-panel comprised of tribal, USFWS, and WDFW fish health experts will convene seasonally to develop measures for limiting the risk of IHN disease transfer and amplification. If IHN disease is detected in any fry groups upon hatching at Umbrella Creek

Hatchery, this panel will likely recommend that infected fry lots be destroyed. The program is expected to be adequately protective of listed and non-listed sockeye salmon through application of these fish disease control policies and measures.

The potential effects from competition of tributary program-origin sockeye salmon with lake spawned sockeye are also evaluated. No spawning ground competition effects on listed sockeye are expected due to separation of the tributary spawning areas for hatchery fish from the lake spawning population beach areas, and expected low straying levels by the hatchery-origin sockeye adults. Spawning ground interactions in Ozette Lake tributaries between natural-origin and F1 hatchery-origin sockeye are monitored to determine whether the abundance of hatchery fish is having a significant density dependent effect on NOR sockeye.

There is a concern that the production of too many sockeye salmon juveniles through the hatchery tributary program could potentially lead to food resource competition between natural and hatchery-origin sockeye during the period when the fish are rearing in Ozette Lake. Information is lacking regarding current productivity conditions and sockeye salmon and kokanee juvenile carrying capacity in Ozette Lake. Studies conducted in the 1980s and 1990s have indicated that sockeye productivity in Ozette Lake has not been limited by food abundance. Bioenergetic simulations (Beauchamp et al. 1995), large smolt size relative to other Washington and Alaskan sockeye populations (Dlugokenski et al. 1981; Jacobs et al. 1996), and high zooplankton abundance levels in Ozette Lake (Bortleson and Dion 1979; Jacobs et al. 1996) are referenced in the HGMP as supportive of the lack of food supply limitations for juvenile sockeye salmon production in Ozette Lake.

Beauchamp and LaRiviere (1993) suggested that less than one percent of the primary available zooplankton food source in Ozette Lake (*Daphnia* sp.) is consumed by either sockeye or kokanee. In a later study, Beauchamp et al. (1995) estimated that an average of 800,000 sockeye salmon fry were produced in Ozette Lake each year. This estimate for fry production in the early to mid-1990s compared favorably with *O. nerka* fry abundance estimates of 490,000 to 1,770,000 from 1982-1991, which were based on the range of sockeye salmon and kokanee spawner abundances observed during 1982-1991. Beauchamp et al. (1995) concluded that food supply in Ozette Lake is unlikely to limit even large sockeye salmon enhancement efforts, defined as a 10 to 50-fold increase in annual fry production above the estimated average production level (800,000 fry). They further concluded that competition for food resources would not limit an extensive sockeye salmon enhancement program in Ozette Lake.

Depressed listed adult sockeye salmon spawning levels since the time of the above studies, and the likely low number of fry, parr, and smolts resulting from beach spawning fish, lend support to the opinion that juvenile sockeye production in the lake remains below carrying capacity. Assuming a recent year (1996-1999) average beach spawner population estimate of 1,424 fish, an average fecundity of 3,097 eggs (1986-98 average), and a deposited egg to swim-up fry survival rate on the beaches of 10%, recent year annual fry production from beach spawners may be estimated to be 220,500. Assuming the same parameters for the recent year average number of 156 tributary

spawners, 24,150 fry could have resulted from natural spawning in Ozette Lake tributaries. Current fry to smolt survival rates in the lake for these natural-origin fry are unknown.

Hatchery sockeye production through the HGMP is limited to 80,000 fed fry at Umbrella Creek and (assuming a 97% survival rate for 140,000 eyed eggs incubated and reared to the emigrating fry stage) 135,800 fry at the Big River site. The total release of approximately 216,000 tributary program-origin sockeye fry ranging in size from 0.15 to 1.0 grams (approximately 173 kg total biomass) is a modest release level for seeding a lake the size of Ozette Lake (the third largest lake in Washington State, with an area of 29.5 km^2). The sum of the planned annual hatchery fry release level and the above annual natural-origin sockeye salmon fry production estimate (460,450 fry total) is well below the 800,000 annual fry production level assumed by the Beauchamp et al. (1995) study which found that food resources were not limiting sockeye salmon juvenile productivity. Given the apparent high productivity of the lake, the low abundance status of beach spawning sockeye fry populations, and the modest annual hatchery production levels proposed through the HGMP, the release of up to 216,000 tributary hatchery program-origin fry is unlikely to overwhelm available food resources in Ozette Lake, and is unlikely to pose competition risks to natural-origin, listed sockeye juveniles.

Results of studies underway through implementation of the HGMP may be used to determine current Ozette Lake Basin juvenile sockeye salmon productivity, and, therefore, the risk of food resource competition effects on natural fish associated with hatchery sockeye production. In particular, annual sockeye salmon smolt abundance and fish size data collected through operation of the floating screw trap in the upper Ozette River will indicate natural and hatchery origin smolt productivity, and (through average fish size comparisons) lake growth conditions for sockeye. NOR fry production data collected through tributary fyke netting, and egg and fry survival evaluations in beach spawning areas (predation study seining, egg basket, and Jordan incubator experiments) will provide further information that can be used in evaluating sockeye salmon productivity and the risk of competitive effects to listed sockeye.

Restricting releases to the fry stage complies with conservation hatchery protocols, which call for the production of hatchery fish of the same life stage as natural-origin species that they may encounter to limit competitive effects. The likelihood of hatchery-origin fish dominating wild individuals in competitive encounters will be reduced if they are of similar size (NMFS 1999). Due to similar fish size and non-pisciverous life history characteristics of co-emigrating juvenile hatchery and natural-origin sockeye salmon, predation by hatchery sockeye is not a risk factor for natural-origin fish (SIWG 1984).

A comprehensive monitoring and evaluation program is included as part of the proposed program. Details regarding the monitoring and evaluation program are provided in section 10 of the HGMP. Meristic and morphometric data are collected from spawners each season to monitor the effects of the tributary hatchery program on the ecological characteristics of the natural-origin and artificially propagated sockeye aggregations. Monitoring of hatchery production at Umbrella Creek will include collection of age class, sex, fish size at adult return, and average fecundity data. Spawning

distribution and abundance will be monitored through stream surveys and a mark recovery program (all hatchery-origin fish are otolith marked, and a sufficient number fish are adipose fin clipped to allow visual identification of adult F1 hatchery fish).

3) Demographic Effects

In addition to evaluations of potential genetic and ecological effects, direct and indirect demographic effects to Ozette Lake sockeye salmon as a result of broodstock collection, biological monitoring, and research-related actions must also be considered. These actions may result in the intentional removal, or the unintentional injury or mortality, of sockeye salmon adults and juveniles. The HGMP quantifies potential demographic effects on sockeye salmon by estimating sockeye adult or juvenile take levels for each proposed artificial propagation and research and monitoring and evaluation action. The program will not impact listed Puget Sound/Washington Coast population segment bull trout (the only other listed salmonid species in the Washington Coastal region) since none are present in the Ozette watershed (WDFW 1999; J. Chan, USFWS, pers. comm.).

a. Artificial propagation

Projected annual sockeye salmon removal levels for those portions of the HGMP involving artificial propagation are: 1) up to 200 natural and hatchery-origin adults removed from Umbrella Creek (and Crooked Creek) as broodstock to supplement tributary production; and 2) up to 10 natural-origin, listed adult sockeye salmon removed from Ozette Lake spawning beaches to produce 3,000 to 6,000 eyed eggs for egg and fry survival research purposes.

Actions resulting in removal of listed sockeye salmon adults from the natural environment for artificial propagation are confined to the tributary broodstock collection program (listed NOR tributary-origin fish), and the study addressing beach-spawned egg and fry survival. The actual numbers of adults returning each year to the Ozette Lake sockeye salmon ESU will be substantially higher than total numbers proposed for take through these actions. The tributary broodstock program is focused on hatchery-origin sockeye salmon returns, and will not lead to the take of adult fish from the core, listed lake spawning population. Maximum broodstock removals from Umbrella Creek will be limited after the 2003 return year to 15% of the total annual adult return to the tributary, or 200 adults (100 pairs), whichever is lower. The number of naturally spawning sockeye salmon in the tributaries is enhanced through the program, and increases in natural spawning levels are fostered through application of total broodstock removal limits. Monitoring programs are implemented to ensure that injury and mortality rates for adult sockeye salmon collected as broodstock are minimized, and that egg to release survival rates for sockeye progeny brought into the hatchery are maximized. Listed sockeye salmon removals from the spawning beaches are very low relative to total annual returns to the lake, and unlikely to impair population survival and recovery. Removals are confined to 10 fish per year, or 0.7% of the recent year (1996-99) average estimated lake spawning population escapement of 1,424. Progeny of the proportionately low number of adults collected from the beaches will be incubated on the beaches through the eyed stage, then removed to assess mortality rates and stage of development. Because

the number of eggs represent a small proportion of the total egg deposition on the beaches (99.3% of the annual beach-origin sockeye population, on average, will spawn naturally) there will be minimal loss in beach spawning sockeye productivity as a result of this study. For these reasons, neither of the programs involving artificial propagation of sockeye salmon are likely to appreciably reduce the likelihood of survival and recovery of the Ozette Lake Sockeye Salmon ESU as a result of demographic reduction effects.

b. Research and monitoring and evaluation

Proposed research and monitoring and evaluation programs are projected to affect the sockeye salmon population as follows (by numbers of fish (Makah 2000) and type of effect): 1) 200 sockeye salmon adults from the run at large in the Ozette River captured, handled, radio/sonic tagged and released for a lake migration, spawning behavior, and pre-spawning survival survey in Ozette Lake in 2001 and 2002. Of the total number handled, 20 may be injured, and 10 fish may be unintentionally killed; 2) removal of up to 3,000 to 6,000 beach spawner-origin eyed eggs (progeny of 10 adults above) planted in egg baskets or incubators on Ozette Lake spawning beaches. Beach spawner survival research will involve sacrificing some or all of these eggs planted on the beaches after a period of time to examine development and mortality rates; 3) up to 1,000 natural-origin fry captured, handled and released in a sockeye fry predation assessment study in the lake directed at piscine predators. Of the total fry handled, 20 may be injured and 20 may be unintentionally killed; 4) 10,000 tributary-origin fry captured, handled, and released in a fyke net study of tributary sockeye spawner productivity in Umbrella Creek. Of the 10,000 fish captured, 400 may be injured, and 300 may be unintentionally killed; and 5) 5,000 lake and tributary-origin smolts captured, handled, sampled, and released through Ozette River juvenile out-migrant study. Of the total number of smolts captured, 250 may be injured and 150 may be unintentionally killed.

Additional monitoring and evaluation actions conducted under the HGMP will not lead to physical contact with live listed sockeye salmon. Habitat and spawning ground surveys may lead to the temporary disturbance of spawners during foot, scuba or boat spawner surveys and carcass and mark recovery projects. Approximately 200 sockeye salmon carcasses may be sampled annually for otoliths, scales, genetic stock identification, and other biological information during spawner surveys, broodstock collection, and through routine monitoring and evaluation activities.

With the exception of planted eyed eggs recovered from gravel or Jordan-type incubators for limiting factors studies (originating from the 10 parent fish removed from beaches accounted for in the above section on artificial propagation demographic effects), proposed research involves capture, handling and release only, and will not lead to the removal of listed adult or juvenile sockeye salmon from the natural environment. Projected incidental sockeye salmon injury and mortality rates resulting from adult sockeye predation and tagging research, and juvenile sockeye trapping programs are low relative to total adult and juvenile sockeye salmon population estimates. The estimated injuries and losses will be spread between listed and unlisted sockeye salmon at proportions to be determined through marked fish recovery analyses (all hatchery-origin sockeye salmon are otolith marked).

As noted above, radio-tagging research may lead to the unintentional loss of a total of 10 natural beach or tributary-origin, or direct (F1) hatchery-origin, adult sockeye salmon. Assuming the 1996-99 average total run size to Ozette Lake of 1,598 (Makah 2000), 0.6% of the listed and unlisted adult sockeye salmon return may be killed through this research program. Up to a total of 320 natural or hatchery-origin fry and 150 smolts may also be unintentionally killed through the other predation and stock assessment studies. Assuming a fry to adult survival rate of 0.6% (Makah 2000) and a smolt to adult survival rate of 10% (Roos 1991), approximately 17 adult sockeye salmon equivalents may be lost as a result of the research, or 1.06% of the total sockeye salmon population, assuming the recent year average listed and unlisted return. The total, estimated listed and unlisted adult sockeye salmon mortality rate resulting from the research is 1.66% of the average annual adult sockeye salmon population escaping to Ozette Lake. Adequate operational measures designed to minimize the potential for injury and mortality of listed sockeye through the research actions are implemented through the HGMP.

Research and monitoring and evaluation have not been identified as factors for decline of the Ozette Lake sockeye salmon ESU, and are generally considered an essential part of salmon and steelhead recovery efforts (NRC 1996). For these programs, the co-managers worked with NMFS and cooperating agencies to develop projects which will benefit the conservation and recovery of the species. The projects will provide information that will enhance the ability to make more effective and responsible decisions to aid listed sockeye salmon. The resulting data will enhance knowledge about Ozette Lake sockeye salmon life history, specific biological requirements, genetic make-up, migration timing, responses to anthropogenic impacts and survival in various parts of the ESU's range. This information will also benefit scientific understanding of sockeye salmon productivity in Ozette Lake, and of factors limiting sockeye abundance and productivity. The results of the research are essential for use by the TRT in making determinations regarding listed sockeye salmon recovery needs.

The actual numbers of adult fish returning each year to the Ozette Lake sockeye salmon ESU will be substantially higher than total numbers proposed for research related take by an order of magnitude or more. It is realistic to expect a similar relationship between juvenile fish abundances and projected take levels occurring through implementation of the HGMP as well. Actual fish mortalities resulting from the research programs are expected to be a small fraction of the total research take (handling and lethal take) for both adults and juveniles. Also, the research activities are distributed throughout the Ozette Lake sockeye salmon ESU's freshwater range, thereby further diminishing the impacts of any take. For these reasons, monitoring and evaluation, and research-related takes are not expected to reduce the Ozette Lake sockeye salmon population, their reproductive capacity or distribution to the point of appreciably reducing their ability to survive and recover in the wild.

5(i)(F) The HGMP describes interrelationships and interdependencies with fisheries management.

The HGMP describes the relationship of the proposed actions with fisheries management. There are currently no known fishery harvest impacts on Ozette Lake sockeye salmon. Ozette Lake sockeye salmon are an early-returning stock, entering freshwater 2 to 3 months prior to Canadian and U.S. Fraser River sockeye-directed marine area fisheries, which occur in July and August. Ozette Lake sockeye salmon are therefore not harvested as migrating adults in pre-terminal marine area commercial fisheries. There has been no harvest of Ozette Lake sockeye salmon in Washington marine waters or in the Ozette Basin by the Makah Tribe for 19 years. There are no plans to initiate fisheries that indirectly or directly harvest listed Ozette Lake sockeye salmon until the population has recovered, and until escapement goals needed to sustain natural spawning aggregations in the Basin are identified.

The long range, future (post sockeye salmon recovery and de-listing) fisheries management goal referenced in the HGMP is to conduct sustainable tribal ceremonial and subsistence and commercial fisheries in conjunction with sustainable non-Indian commercial and/or recreational fisheries. A harvest management plan will be developed prior to initiation of any commercial fisheries in the future. If the hatchery program implemented through the HGMP is still needed for conservation purposes after the Ozette Lake sockeye salmon ESU has been recovered and de-listed (e.g., if specific sockeye salmon spawning aggregations within the delisted ESU still require supplementation), the HGMP will be reassessed. Future commercial fisheries will occur only after establishment of escapement goals for spawning aggregations, and when sufficient numbers of harvestable surplus fish are present. The HGMP under review is not intended to produce sockeye salmon for the purpose of sustaining harvests in commercial or recreational fisheries in the near term.

5(i)(G) Adequate artificial propagation facilities exist to properly rear progeny of naturally spawned broodstock, to maintain population health and diversity, and to avoid hatchery-influenced selection and domestication.

Artificial propagation facilities and water sources used to collect and hold listed and non-listed broodstock, incubate eggs, and rear and release juvenile fish are described in the HGMP (section 4). Included in this section are assessments of ecological and genetic risks of the proposed artificial propagation actions, and descriptions of measures applied at the facilities to minimize the likelihood for adverse effects to natural-origin sockeye salmon under propagation. Listed (NOR) and non-listed (F1) sockeye salmon adults are collected as broodstock for the tributary hatchery program. Under the 4(d) Rule, take of listed NOR adult fish returning to the tributaries for use as broodstock is excepted from protective regulations, as the program is part of an overall conservation program. In addition, the progeny of natural-origin sockeye salmon spawned through the tributary hatchery program are not considered listed (65 FR 14528, March 25, 1999). Natural-

origin, but not ESA-listed, sockeye salmon are therefore the focus of this evaluation of the adequacy of the HGMP's artificial propagation facilities.

Under the HGMP, four separate hatchery locations are proposed for use. Broodstock are trapped at either Umbrella Creek or Crooked Creek using a temporary weir (Umbrella Creek) or seines (both locations). The timing of these trapping operations, and methods applied, have been previously described. Available facilities allow for the collection, holding, and spawning of a representative sample of the tributary sockeye salmon return. The types of facilities and methods proposed for application are routinely used to effectively collect salmon broodstock, and are adequate for maintaining the health and diversity of the captured adult population, and their progeny. Adult fish that are not spawned at the tributary location of capture are transferred to Umbrella Creek Hatchery for holding through spawning. The hatchery relies on a stable, gravity fed water supply that limits the likelihood for water, and subsequently, adult fish loss. Adequate measures are described in the HGMP to safeguard adult fish held against loss due to equipment failure, water loss, flooding, and fish disease. Umbrella Creek Hatchery spawning facilities (and practices applied during spawning) are considered adequate for maintaining population health and diversity and avoiding hatchery-induced selection effects.

Gametes secured from sockeye salmon spawners are transferred for fertilization and incubation at Makah NFH, with Educket Hatchery as a back-up location. Makah NFH has a stable, high quality water supply, back-up power and water generation capabilities, on-site staffing, and iso-incubation capabilities that limit the potential for fish loss, and adverse health and diversity effects, through the critical green to eyed egg life stage. The USFWS facility also allows for the safe mass otolith-marking of incubating eggs through thermal regulation of the water supplies. Monitoring and prevention of the amplification of IHN disease is an important function of the HGMP. Water supplies, incubation facilities, and operational practices applied at hatchery locations are designed to limit the occurrence of IHN disease in the propagated sockeye population, and limit risks to downstream natural populations. Isoincubation options provided at Makah NFH allow for segregation of sockeye salmon families, helping to preserve gene pool variability and maximize the number of adult crosses represented in subsequent juvenile sockeye releases.

Eyed eggs produced at either Makah NFH or Educket Hatchery are transferred to Umbrella Creek Hatchery or to RSIs located adjacent to the Big River for continued incubation through hatching. Transfer of sockeye salmon from the above incubation facilities to these locations as eyed eggs allows for imprinting to the release sites, and limits the risk of straying to non-target tributaries or lake spawning beaches. Umbrella Creek Hatchery and the Big River RSIs rely on stable, gravity-fed water supplies, which decrease the likelihood for water loss, and catastrophic fish loss. Incubation facilities at the two locations, and incubation and fish disease control practices applied at the facilities, are designed to safeguard sockeye salmon health and diversity.

High annual average survival rates for sockeye salmon propagated at Umbrella Creek Hatchery (recent 12 year average eyed egg to swim-up and swim-up to release survival rates were 98.3% and 86.0%, respectively) are indicative of a well designed and operated program. Incubation and

fish rearing vessel volumes, and water supply rates, are sufficient to allow for rearing of fish at Umbrella Creek Hatchery at low densities, leading to the production of healthy fish. Nopad-style incubators used to incubate sockeye to the swim-up stage are loaded well below their 500,000 egg capacity (a total of less than 90,000 eyed eggs will be incubated each year), and are supplied with sufficient flow (12 to 20 gpm) to maintain very low incubation densities. Use of rugose incubation substrate and maintenance of eggs under darkened conditions mimics natural conditions for newly hatched fry, and complies with NMFS conservation hatchery recommendations (NMFS 1999). The types of incubators used (Nopad-style, Jordan-style, and RSIs) also allow volitional fry emigration, further mimicking natural conditions. Allowance for volitional migration complies with NMFS recommendations for the operation of conservation hatcheries to maintain population variability in migration behavior and to ensure that fry are physiologically ready for out-migration (NMFS 1999). Sockeye salmon fry densities in rearing vessels at the hatchery are maintained below 0.5 pounds fish per ft^3 rearing space, to maintain fish health, and minimize the risk of fish disease epizootics. Maintenance of rearing densities below 0.5 pounds fish per ft^3 rearing space also conforms with NMFS conservation hatchery guidelines (NMFS 1999).

The use of RSIs or Jordan-style incubators, and release of unfed fry directly into Big River, limits the likelihood for hatchery-induced selection and domestication effects and divergence from the naturally spawned populations. Facilities allowing the release of fed fry reared for 60 to 90 days from Umbrella Creek Hatchery and the Big River site also decreases the risk of hatchery selection and domestication effects to sockeye salmon under propagation. Facilities, and fish rearing practices applied, adequately minimize the risk of adverse genetic effects to the propagated population as a result of rearing.

5(i)(H) Adequate monitoring and evaluation exist to detect and evaluate the success of the hatchery program and any risks potentially impairing the recovery of the listed ESU.

A comprehensive monitoring and evaluation program is proposed to evaluate the performance of the hatchery program in establishing self-sustaining sockeye salmon aggregations in the tributaries, and the potential adverse effects of the HGMP on recovery of listed sockeye salmon. Section 10 of the HGMP ("Monitoring and Evaluation of Performance Indicators") provides a detailed explanation of monitoring and evaluation measures proposed for the Ozette Lake sockeye salmon program. Additional details regarding the monitoring and evaluation programs are also provided in previous sections of this evaluation and recommended determination document

Evaluation of the success of the hatchery program is accomplished by estimating annual sockeye adult escapement levels to the target tributaries, F1 and NOR tributary-spawning sockeye escapement proportions, and fry to adult survival rates for hatchery-origin fish. These parameters will be estimated by marking (via thermal marking of otoliths) all hatchery-origin sockeye eyed eggs and fry to allow for their differentiation from natural-origin fish upon return as adults on the spawning grounds. Spawning ground surveys conducted throughout the annual sockeye salmon return period will enumerate spawners, and collect information regarding fish origin (via

observation of live fish for fin clip marks, and carcass and broodstock sampling for otoliths), and age class composition (scale and otolith sampling of brood stock and carcasses). Abundance and mark recovery information gathered will be used to estimate total tributary escapements and F1 and NOR proportions. Spawner surveys and mark recovery programs in adjacent non-supplemented tributaries and in lake spawning areas will be used to estimate hatchery-origin sockeye salmon stray rates. Spawner escapement estimates for F1 hatchery fish will be applied to appropriate brood year fry release numbers to estimate F1 fry to adult survival rates. NOR spawner escapement estimates will be compared with contributing brood year NOR spawner counts to estimate spawner-to-spawner replacement rates.

Changes in the genetic, phenotypic, or ecological characteristics of the artificially propagated sockeye salmon population are monitored through the collection and analyses of meristic, morphometric, and genetic stock identification data from hatchery and natural-origin adult fish returning to Umbrella Creek and Big River (summarized in HGMP section 10.4.6 and in HGMP Attachment 2). The need, and methods, for improvement of hatchery operations or, if warranted, the need to discontinue the program are determined through evaluation of monitoring results. Monitoring includes collection of hatchery fish survival, fish health status, and growth information during propagation. Monitoring of broodstock procurement efforts for compliance with program performance and impact reduction objectives (e.g., number of fish, distribution across the total return, representation of total return characteristics) will also occur (HGMP section 10.4.6.)

Monitoring and evaluation to detect and evaluate any risks potentially impairing the recovery of the listed ESU are included in the HGMP. The objective of the program is to establish tributary-spawning sockeye aggregations, while limiting hatchery-origin sockeye stray rates to lake spawning areas for genetic and ecological diversity preservation purposes. Establishment of self-sustaining natural spawning aggregations in the tributaries may benefit recovery of the ESU, subject to future TRT determinations.

The number of adult fish collected from the tributaries for use as broodstock, and the number of eyed eggs and fry produced each year will be monitored to ensure that the program remains within stated annual levels. The number of sockeye salmon adults (10) collected for beach-spawned egg and fry survival research purposes will also be monitored and limited (as described in HGMP section 10.4.6.)

Monitoring of tributary-origin hatchery fish straying onto Ozette Lake spawning beaches occurs through observation and recovery of marked hatchery fish. As previously stated, all hatchery-origin fish are marked with an otolith mark, and a proportion of sockeye salmon released as fed fry are additionally marked with an adipose fin clip. Fin clipped fish returning as adults are monitored at the Ozette River counting weir to provide an inseason estimate of the proportion of hatchery-origin sockeye entering the lake each year. Otoliths will be recovered from sockeye spawned within the hatchery program and from carcasses and spawned-out fish recovered during spawning ground surveys. Otolith mark recovery data will be combined with fin clip recovery information (counting weir and additional observations from spawning ground surveys) to determine stock

(hatchery vs. natural-origin) and release type (unfed vs. fed fry) contribution rates and hatchery-origin sockeye stray rates to lake spawning areas. Genetic research is also proposed to monitor hybridization and gene flow among sockeye and kokanee aggregations in the Basin. Tissue samples are collected from sockeye and kokanee during spawning ground surveys for DNA analysis, to develop baseline genetic profiles of sockeye and kokanee populations for future monitoring of genetic change.

Research that will provide information useful for evaluating factors limiting productivity of the listed sockeye population is also proposed. This research includes adult sockeye capture and tagging programs to assess prespawning mortality rates (e.g., due to predation) and sockeye salmon beach spawning locations and pre-spawning behavior in Ozette Lake. Sockeye fry and out-migrant smolt trapping programs are also proposed to estimate natural and hatchery-origin fry and smolt production levels. To ensure that these actions do not impair recovery of the listed sockeye salmon ESU, the number of sockeye that may be captured, handled, tagged, and released through these programs is limited (see page 42). Allowable, combined listed and non-listed juvenile and adult sockeye take levels for these research actions are low (estimated unintentional mortality of 1.66% - see page 43) relative to total sockeye salmon adult abundance levels, and unlikely to impair recovery. The number of sockeye that are captured and released, the number that are injured in the process, and the number that are incidentally killed during handling will be monitored (HGMP section 10.4.6) to ensure that take levels remain at or below estimated take levels (HGMP section 11, Table 1).

Adequate measures for monitoring HGMP performance, and for determining the effects of the program on recovery of the listed Ozette Lake sockeye salmon ESU are proposed.

5(i)(I) The HGMP provides for evaluating monitoring data and making any revisions of assumptions, management strategies, or objectives that data show are needed.

The HGMP provides for evaluating monitoring data, and using results to adjust hatchery and research programs as needed to improve performance or reduce unanticipated adverse effects on listed fish. Monitoring data evaluation and plan revision objectives and processes are outlined in the plan "Introduction" section, under "Overall Approach", "Program Strategy" and "Risk Management" headings. Specific details regarding evaluation of hatchery, monitoring and evaluation and research data and planned revisions are presented in the "Monitoring and Evaluation" section (section 10), the "Research" section (section 11), and in HGMP sections 5 through 9, where management responses to unknowns or uncertainties are included (sections 5.3, 6.3, 7.5, 8.15, and 9.8).

In compliance with this 4(d) Rule criterion, the HGMP applies adaptive management and risk management approaches in its implementation of hatchery and research actions. These approaches are applied in response to uncertainties regarding the effects of hatchery actions and sockeye salmon recovery needs. HGMP actions directed at listed sockeye recovery and the identification

of limiting factors are therefore treated as "experiments." The applied approach is to gather and respond to information regarding the effects of the tributary hatchery program, and factors limiting listed sockeye productivity. The adaptive management strategy has four steps (taken from the HGMP): 1) identifying recovery strategies that test hypotheses about limiting factors or causes of decline of the listed sockeye population; 2) designing recovery activities as experiments to collect information from which the co-managers can learn; 3) analyzing the response to recovery activities; and 4) implementing changes in the HGMP based on synthesis of information and adaptive management.

The establishment of a decision-making framework for implementing program changes is included in the HGMP as a performance indicator to gauge compliance with the plan's adaptive management performance standard. In this vein, technical work groups convened under the "Lake Ozette Sockeye Steering Committee," including MFM, WDFW, USFWS, NPS, and Quileute tribal representatives, will meet periodically with NMFS Northwest Region staff during the year to exchange and evaluate data gathered through implementation of the HGMP. The work groups will make recommendations to revise the program, or to terminate certain actions conducted through the HGMP, if annual program indicator monitoring and evaluation results demonstrate that aspects of the program are failing to meet performance standards and the program cannot be corrected through adaptive management to provide a net benefit to the ESU. Evaluations and recommendations developed by the technical work groups will be used by the co-managers to modify HGMP hatchery, monitoring and evaluation, and research actions as necessary to respond to listed sockeye recovery needs, unanticipated adverse program effects on listed sockeye salmon, tributary hatchery program performance improvement needs, or information gaps. Additional meetings and exchanges will occur as needed to develop recommendations for management actions pertinent to the HGMP, resolve differences in approaches, and review monitoring program results. Data from the monitoring and evaluation and research programs form the basis for development and refinement of tributary hatchery and limiting factors identification efforts.

Annual reports assembled by the co-managers (led by the Makah Tribe) for the program will be reviewed by the co-managers, technical work group members, and NMFS to document program results, and to determine if the program needs to be adjusted to meet adaptive management objectives of the HGMP. These reports will be completed in April of each year, and will be displayed on the NMFS Northwest Region website with the HGMP for public information purposes.

5(i)(J) NMFS provides written concurrence of the HGMP which specifies the implementation and reporting requirements.

After completion of the public review and comment period for this evaluation/determination document, NMFS will make a determination regarding the adequacy of the RMP. If the determination is made that the RMP addresses all of the criteria specified in Limit 6 of the 4(d)

Rule, NMFS will issue a letter of concurrence to the co-managers to implement the Ozette Lake sockeye salmon program in accordance with the final RMP.

5(i)(K) The HGMP is consistent with plans and conditions set within any Federal court proceeding with continuing jurisdiction over tribal harvest allocations.

This RMP was developed by the co-managers pursuant to the *United States v. Washington* (1974) fisheries and hatchery management framework. The RMP is part of an overall Ozette Lake sockeye salmon ESU recovery plan under development by the co-managers. The ESU recovery plan has hatchery and habitat components, which include monitoring, research, and habitat protection, assessment, and restoration recommendations to complement artificial production.

There are no other plans or conditions set within Federal court proceedings, including memorandums of understanding, court orders or other management plans, that direct operation of the proposed program.

Notice of Pending Recommendation

As required by the 4(d) Rule, the Secretary is making available for public review his pending determination as to whether the RMP would appreciably reduce the likelihood of survival and recovery of the listed salmonids.

Notice of Recommended Determination

As required in (6)(iv) of section 223.203 of the 4(d) Rule for Ozette Lake sockeye salmon, the Secretary will publish notice of his determination as to whether the RMP appreciably decreases the likelihood for survival and recovery of affected threatened ESUs, together with a discussion of the biological analysis underlying that determination.

PENDING DETERMINATION

Pending consideration of comments received, the Northwest Region Sustainable Fisheries Division expects to recommend a finding that the RMP for Ozette Lake sockeye salmon provided by the Makah Tribe, and WDFW as co-manager of the salmon resource, addresses all of the criteria established for a RMP under Limit 6 of the 4(d) Rule.

Reevaluation Criteria

NMFS will reevaluate this determination if: (1) the actions described by the RMP are modified in a way that causes an effect on the listed species that was not previously considered in NMFS' evaluation; (3) new information or monitoring reveals effects that may affect listed species in a way

not previously considered; or (4) a new species is listed or critical habitat is designated that may affect NMFS' evaluation of the RMP.

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